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NO. 333, Revised

RANGER LAUNCH VEHICLE INTEGRATION SUMMARY

ED 333, Revised 27 June, 1967

W. J. Lane

D. J. Stelma

H. J. Margraf

H. J. Margraf, Manager
Launch Vehicle Integration

JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA

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PREFACE

The Ranger Project was established to develop a space-flight technology for transporting engineering and scientific instruments to the Moon and to the planets (Ref. 1). The nine Ranger launchings all made use of the Atlas D/Agena B combination (Table 1) as the injection vehicle.

Rangers I and II (Block I) were not specifically lunar-oriented, but were engineering evaluation flights for testing the basic systems to be employed in later lunar and planetary missions. Several scientific experiments were carried on a noninterference basis. Both spacecraft performed satisfactorily within the constraints of the low earth orbits obtained.

Rangers III, IV, and V (Block II) carried a gamma-ray instrument, a TV camera, and a rough-landing seismometer capsule. All of these flights experienced failures.

The objective of Rangers VI, VII, VIII, and IX (Block III) was to obtain pictures of the lunar surface at least one order of magnitude better than those obtainable with Earth-based photography to benefit both the scientific program and the U. S. manned lunar-flight program. The Ranger VI spacecraft, which was launched from the Air Force Eastern Test Range (AFETR) on January 30, 1964, did not accomplish the primary flight objective because of a failure of the TV subsystem to transmit pictures. An extensive analysis of the TV subsystem was performed. The Ranger VII spacecraft was launched from AFETR on July 28, 1964, and impacted the Moon on target on July 31, 1964, accomplishing the mission flight objective. The outstanding events of the mission were the smooth countdown, the precision of the trajectory correction, and the transmission of 4304 video pictures of the lunar surface. Rangers VIII and IX, launched on February 17, 1965, and March 21, 1965, respectively, repeated the success of Ranger VII in a spectacular manner and brought the Ranger Project to a successful conclusion.

Section I of this document is a narration of all major efforts and results pertaining primarily to the launch vehicle system and its adaptation for use in executing Ranger missions. The time period from cancellation of Vega launch vehicle development to the end of the Ranger Program is covered in "Block" concept for convenience in reporting (Fig. 1). Overlaps naturally occur in the time scale because of the necessity for maintaining continuous test programs and constant evaluation, and for establishing lead times for design changes. Regardless of these time overlaps, however, the Block designation clearly separates the missions and serves to indicate milestones in the accomplishment of the final Project Objectives.

Specific activities and accomplishments in the areas pertaining to spacecraft/launch vehicle integration design, testing, and documentation are given separate and more detailed treatment in Sections II and III.

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CHANGE RECORD FOR ENGINEERING DOCUMENT 333

PAGE	ITEM	DATE	DESCRIPTION OF CHANGE
	Title Page	7-8-66	Added "Revised" and changed date
xi	Change Record	6-19-67	Added "Change Record"
15	Figure 8	7-8-66	Corrected figure
39	Para. 6	7-8-66	Combined 2nd and 3rd sub-paragraphs
40	Para. 7	7-8-66	Added "at JPL" to 1st sub-paragraph
53	Table IV	7-8-66	Added column titles
132	Para. b(2)	7-8-66	Corrected spelling "zinc"
263	Glossary	7-8-66	Corrected spelling "hydrazine"

SECTION I. CHRONOLOGY

A. RANGER BLOCK I

1. Evolution of Launch Vehicles from the Juno Experiments

During the Juno I (Explorer) and Juno II (Pioneer) experiments of 1958-59, personnel from the Jet Propulsion Laboratory (JPL), and from the Army Ballistic Missile Agency (ABMA) made design studies for the purpose of improving the payload capacity of the Jupiter booster through the use of larger and more efficient upper stages (Ref. 2). The first vehicle family considered was Juno III. Its design was based upon the use of a spinning cluster of solid rockets which were similar to, but larger than, the JPL-built clusters used on the Juno I and II spacecraft. The Juno III concept was rejected on the grounds that future flight missions would require spacecraft guidance and stabilization; consequently, the spinning upper stages would be undesirable.

The ensuing studies of a Juno IV vehicle family proposed the use of guided liquid-propelled upper stages on the Jupiter booster. The power plants considered for these stages were:

a. A proposed JPL 6000-lb-thrust engine, (pressure-fed, N_2O_4-N_2H_4, storable)

b. The Aerojet Able or Able/Star propulsion system (7500-lb-thrust, pressure-fed, IRFNA UDMH, storable)

c. The Bell HUSTLER power plant (15,000-lb-thrust, pump-fed, IRFNA UDMH, storable, later used in the Lockheed Agena stage)

d. The General Electric 405 engine (33,000-lb-thrust, pump-fed, liquid oxygen-kerosene, modified from the Vanguard first-stage power plant)

e. A proposed JPL 45,000-lb-thrust engine (pressure-fed N_2O_4-N_2H_4, storable)

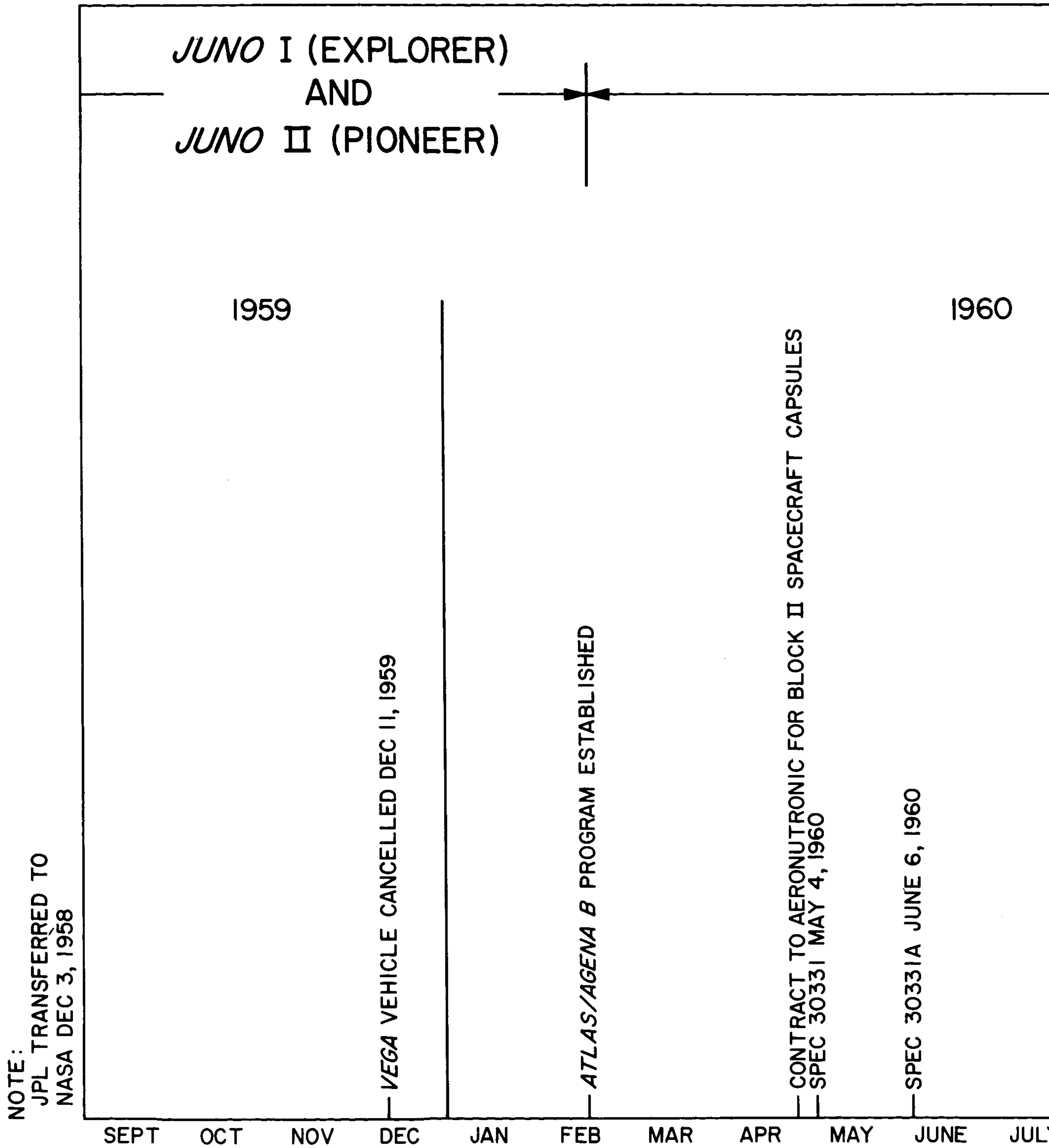
ABMA favored the pump-fed engines, while JPL preferred the pressure-fed power plants.

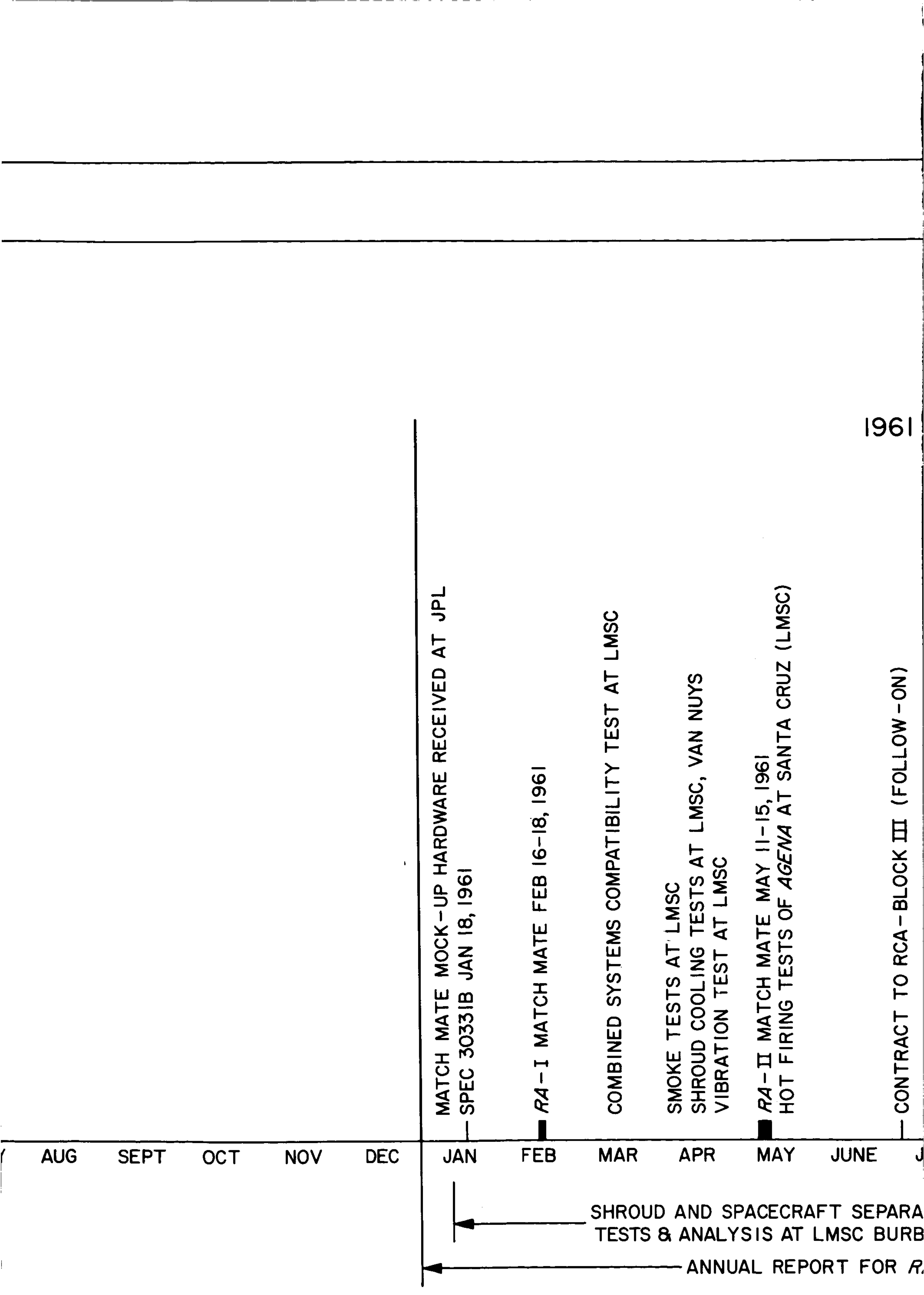
Concurrently with the Juno IV effort, ABMA was making studies, under the title Juno V, of vehicles in the million-pound-thrust class which led eventually to the Saturn Project.

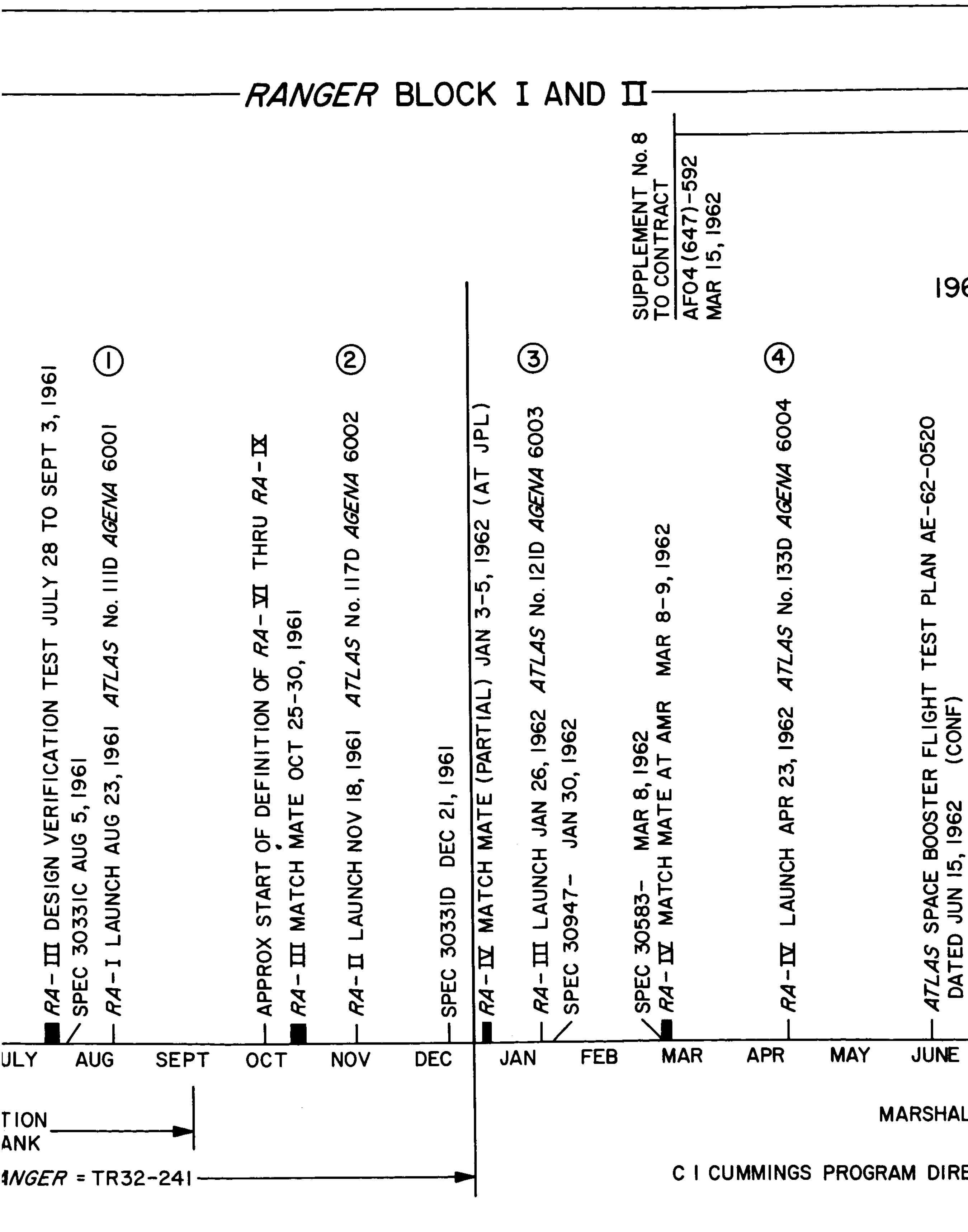
In mid-1958, the Advanced Research Projects Agency (ARPA) ordered the development of both Juno IV and Juno V. In August 1958, ABMA was authorized to proceed with the 1-1/2-million-pound-thrust, clustered-engine Saturn. In December 1958, JPL was transferred to NASA while the von Braun team remained under ABMA, and the Juno IV project was cancelled. JPL's Juno IV effort is recorded in Ref. 1.

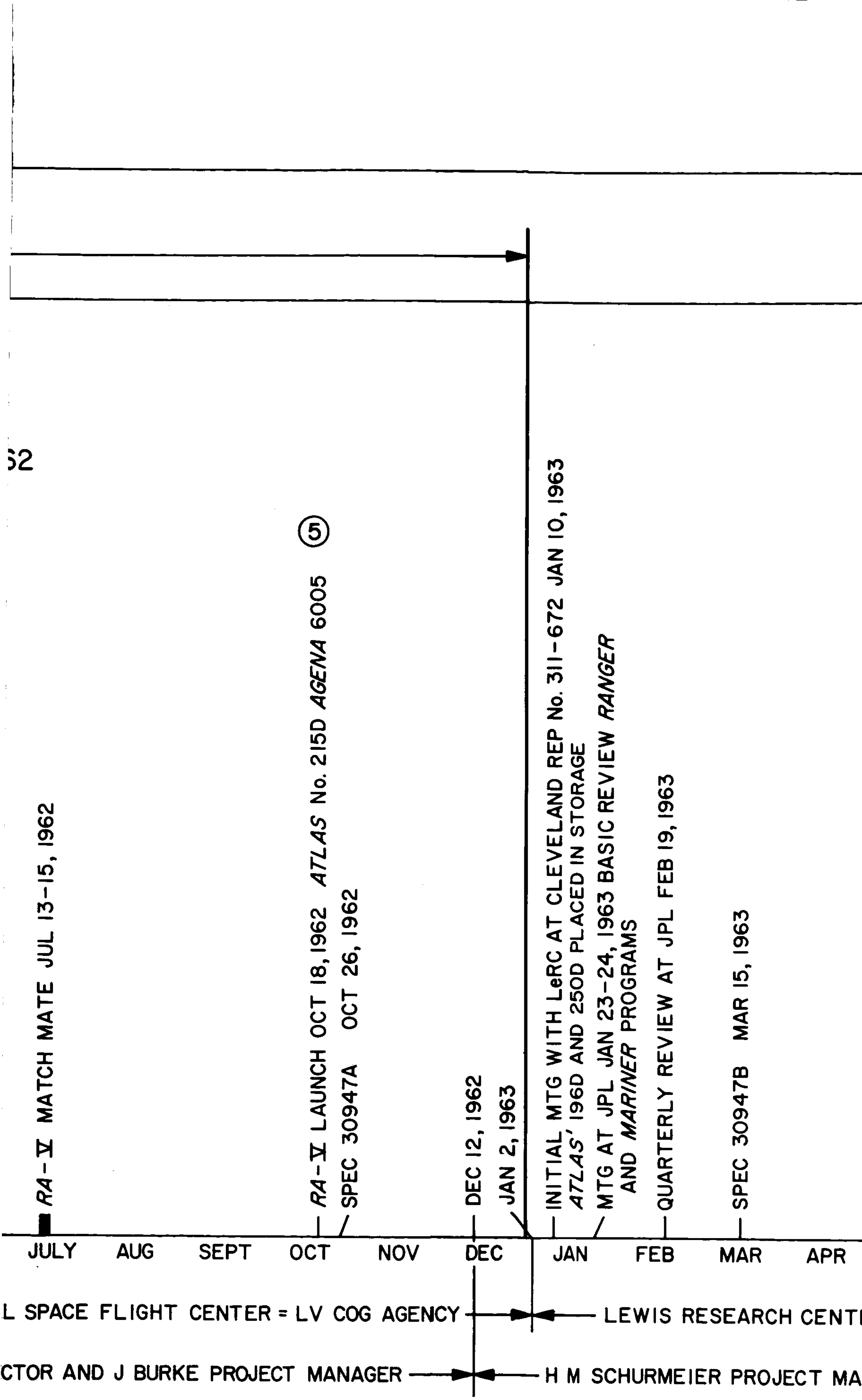
Table I. Correlation of Launch Vehicle and Ranger Spacecraft Serial Numbers

Spacecraft	Block No.	Agena Ser. No.	Adapter Dwg. No.	Atlas Ser. No.	Remarks
RA-1	I	6001	1314318	111D	
RA-II	I	6002	1314518	117D	
RA-III	II	6003	1314318	121D	
RA-IV	II	6004	1314318	133D	
RA-V	II	6005	1314318	215D	
RA-VI	III	6008	1359755	199D	New Adapter built without Diaphragm
RA-VII	III	6009	1360210 1338541	250D	Adapter Reworked from the Mariner R Spare
RA-VIII	III	6006	1360224 1314318	196D	Adapter Reworked from one Originally Fabricated to Ranger Block II Drawings
RA-IX	III	6007	1359755	204D	New Adapter Built without Diaphragm


JUNO I (EXPLORER)
AND
JUNO II (PIONEER)
1959
1960
NOTE:
JPL TRANSFERRED TO
NASA DEC 3, 1958
VEGA VEHICLE CANCELLED DEC 11, 1959
ATLAS/AGENA B PROGRAM ESTABLISHED
CONTRACT TO AERONUTRONIC FOR BLOCK II SPACECRAFT CAPSULES
SPEC 30331 MAY 4, 1960
SPEC 30331A JUNE 6, 1960
SEPT
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE


1961
MATCH MATE MOCK-UP HARDWARE RECEIVED AT JPL
SPEC 30331B JAN 18, 1961
RA-I MATCH MATE FEB 16-18, 1961
COMBINED SYSTEMS COMPATIBILITY TEST AT LMSC
SMOKE TESTS AT LMSC
SHROUD COOLING TESTS AT LMSC, VAN NUYS
VIBRATION TEST AT LMSC
RA-II MATCH MATE MAY 11-15, 1961
HOT FIRING TESTS OF AGENA AT SANTA CRUZ (LMSC)
CONTRACT TO RCA-BLOCK III (FOLLOW-ON)
AUG
SEPT
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
SHROUD AND SPACECRAFT SEPARA
TESTS & ANALYSIS AT LMSC BURB
ANNUAL REPORT FOR R


RANGER BLOCK I AND II
SUPPLEMENT No. 8 TO CONTRACT AF04(647)-592 MAR 15, 1962
196
① RA-III DESIGN VERIFICATION TEST JULY 28 TO SEPT 3, 1961
SPEC 30331C AUG 5, 1961
RA-I LAUNCH AUG 23, 1961 ATLAS No. 111D AGENA 6001
APPROX START OF DEFINITION OF RA-VI THRU RA-IX
RA-III MATCH MATE OCT 25-30, 1961
② RA-II LAUNCH NOV 18, 1961 ATLAS No. 117D AGENA 6002
SPEC 30331D DEC 21, 1961
RA-IV MATCH MATE (PARTIAL) JAN 3-5, 1962 (AT JPL)
③ RA-III LAUNCH JAN 26, 1962 ATLAS No. 121D AGENA 6003
SPEC 30947- JAN 30, 1962
SPEC 30583- MAR 8, 1962
RA-IV MATCH MATE AT AMR MAR 8-9, 1962
④ RA-IV LAUNCH APR 23, 1962 ATLAS No. 133D AGENA 6004
ATLAS SPACE BOOSTER FLIGHT TEST PLAN AE-62-0520 DATED JUN 15, 1962 (CONF)
ULY
AUG
SEPT
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
TION
ANK
NGER = TR32-241
MARSHAL
C I CUMMINGS PROGRAM DIRE



52
RA-V MATCH MATE JUL 13-15, 1962
RA-V LAUNCH OCT 18, 1962 ATLAS No. 215D AGENA 6005 ⑤
SPEC 30947A OCT 26, 1962
DEC 12, 1962
JAN 2, 1963
INITIAL MTG WITH LeRC AT CLEVELAND REP No. 311-672 JAN 10, 1963
ATLAS' 196D AND 250D PLACED IN STORAGE
MTG AT JPL JAN 23-24, 1963 BASIC REVIEW RANGER AND MARINER PROGRAMS
QUARTERLY REVIEW AT JPL FEB 19, 1963
SPEC 30947B MAR 15, 1963
JULY
AUG
SEPT
OCT
NOV
DEC
JAN
FEB
MAR
APR
L SPACE FLIGHT CENTER = LV COG AGENCY
LEWIS RESEARCH CENT
CTOR AND J BURKE PROJECT MANAGER
H M SCHURMEIER PROJECT MA

RANGER BLOCK III

1963 | 1964

- QUARTERLY REVIEW AT JPL MAY 21, 1963
- LV REVIEW AT LeRC JUN 3-5, 1963
- *RA* BLOCK IV L/V SPACECRAFT INTEGRATION DOCUMENT EDA-161, JUN 10, 1963
- *RA* BLK IV CANCELLED JUL 12, 1963
- QUARTERLY REVIEW AT JPL AUG 13, 1963
- SCHED FOR LAUNCH AS OF SEPT 4, 1963; *RA*-VI DEC 3, 1963 *RA*-VII JAN 2, 1963; *RA*-VIII MAR 30, 1964; *RA*-IX APR 29, 1964
- *RA*-VI MATCH MATE SEPT 4-7, 1963 REP 311-691
- SPEC 30947C SEPT 15, 1963
- *RA* BLOCK V L/V REQUIREMENTS EPD 182 OCT 2, 1963
- FINAL DESIGN REVIEW AT LMSC OCT 17, 1963 RE-ORDER 63-675
- *RA*-VII MATCH MATE OCT 15-21, 1963 REP 311-697 & 311-695
- FLIGHT TERMINATION SYSTEM RE-ORDER 63-433 ALSO 64-268
- *RA* BLK V CANCELLED DEC 13, 1963
- SPEC 30583A DEC 18, 1963
- AMEND TO 30947C JAN 10, 1964
- (6) *RA*-VI LAUNCH JAN 30, 1964 *ATLAS* No. 199D *AGENA* 6008
- *RA*-VI POST FLIGHT REVIEW AT JPL FEB 7, 1964
- *RA*-VIII MATCH MATE FEB 11-14, 1964 REP 311-705
- REPEAT OF SPRING CONSTANT TESTS ON *RA*-8 APRIL 20-22, 1964 REF *RA*-LV-90251
- QUARTERLY REVIEW AT JPL JUN 23, 1964

MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUNE | JU

R = LV COG AGENCY

IAGER

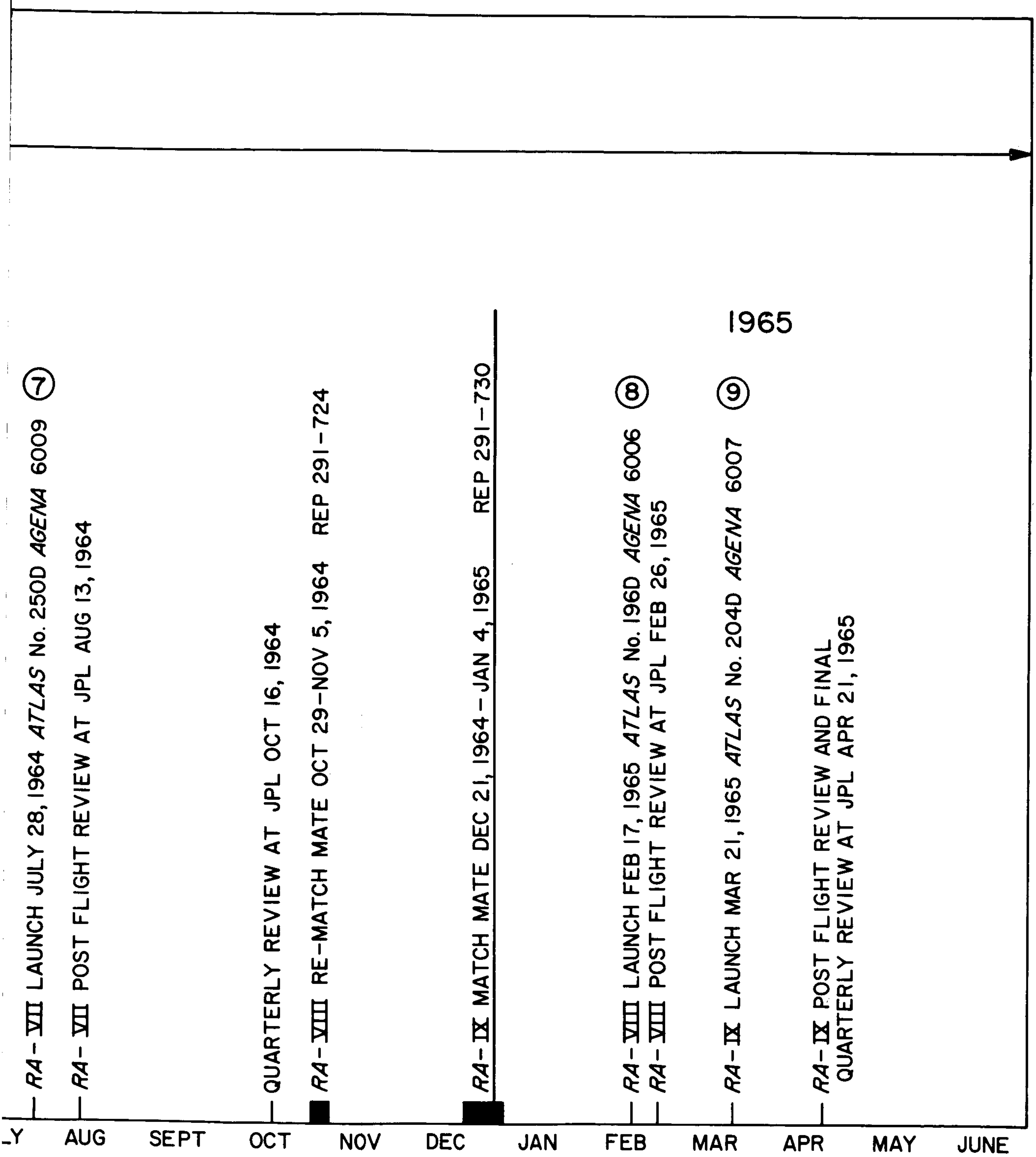


Figure 1. Launch Vehicle Integration Chronology

The mission and payload design studies made during 1958 gave evidence that useful lunar and planetary experiments were barely feasible using payload weights available with IRBM-based (50-ton class) vehicles such as Thor/Able and Juno IV. It was therefore decided that future JPL deep-space missions should be based on ICBM (100-ton) boosters, although this was regarded as a very risky and expensive step. The choice between Titan and Atlas was made in favor of Atlas (Fig. 2) because flight tests of the latter had been started earlier.

The selection of upper stages for the Atlas, occurring simultaneously with the organizational changes mentioned above, was complicated by many problems. In addition to the list of rockets previously considered for Juno IV, the Centaur (30,000-lb-thrust, pump-fed, liquid oxygen-hydrogen) was now available and was being proposed to the U. S. Air Force (USAF) by Convair/Astronautics. Because of anticipated development difficulties due to the use of liquid hydrogen in the Centaur, NASA decided that Convair should also develop an interim stage, to be known as Vega, which would use the GE 405 liquid oxygen kerosene engine. JPL studies, however, indicated that another stage would have to be added for the deep-space missions, and early in 1959, NASA authorized development of a vehicle which would include the JPL 6000-lb-thrust third stage for escape shots and would use only the first two stages for launching Earth satellites. NASA established a contract with General Electric for the GE 405 engine and with Convair/Astronautics for the second-stage development. JPL was requested to build the third stage and the deep-space payloads, and to assume technical direction of the vehicle development.

During the summer of 1959, the Ames Research Center (ARC) of NASA was exploring various prospects for the design of an attitude-stabilized meteorological satellite to be launched by the two-stage Vega. One proposal was to use the Agena B satellite being developed by the Lockheed Missile Systems Division (LMSD) for the USAF, without the propulsion system. An earlier version, Agena A, was already being used in the ARPA USAF Discoverer Program. In the course of examining the Agena B proposal, JPL personnel became convinced that the Agena stage could be used in place of the Vega stage on the Atlas. Further studies indicated that, for most missions, the Agena B (Fig. 3) would perform better than the Vega. The turbo-pump-fed engine of the Agena B, powered by UDMH IRFNA, developed a 15,000-lb-thrust, and the system had a restart capability that could be used for transferring a spacecraft from a parking orbit into a lunar trajectory.

On December 11, 1959, NASA cancelled the Vega vehicle development and redirected the efforts of JPL to designing the 6000-lb-thrust for propulsion research. The recommendations of a NASA group (which included JPL personnel) led to the establishment of the NASA Atlas/Agena B program in February 1960, under the direction of the von Braun team, which by then had joined NASA as the nucleus of the Marshall Space Flight Center (MSFC).

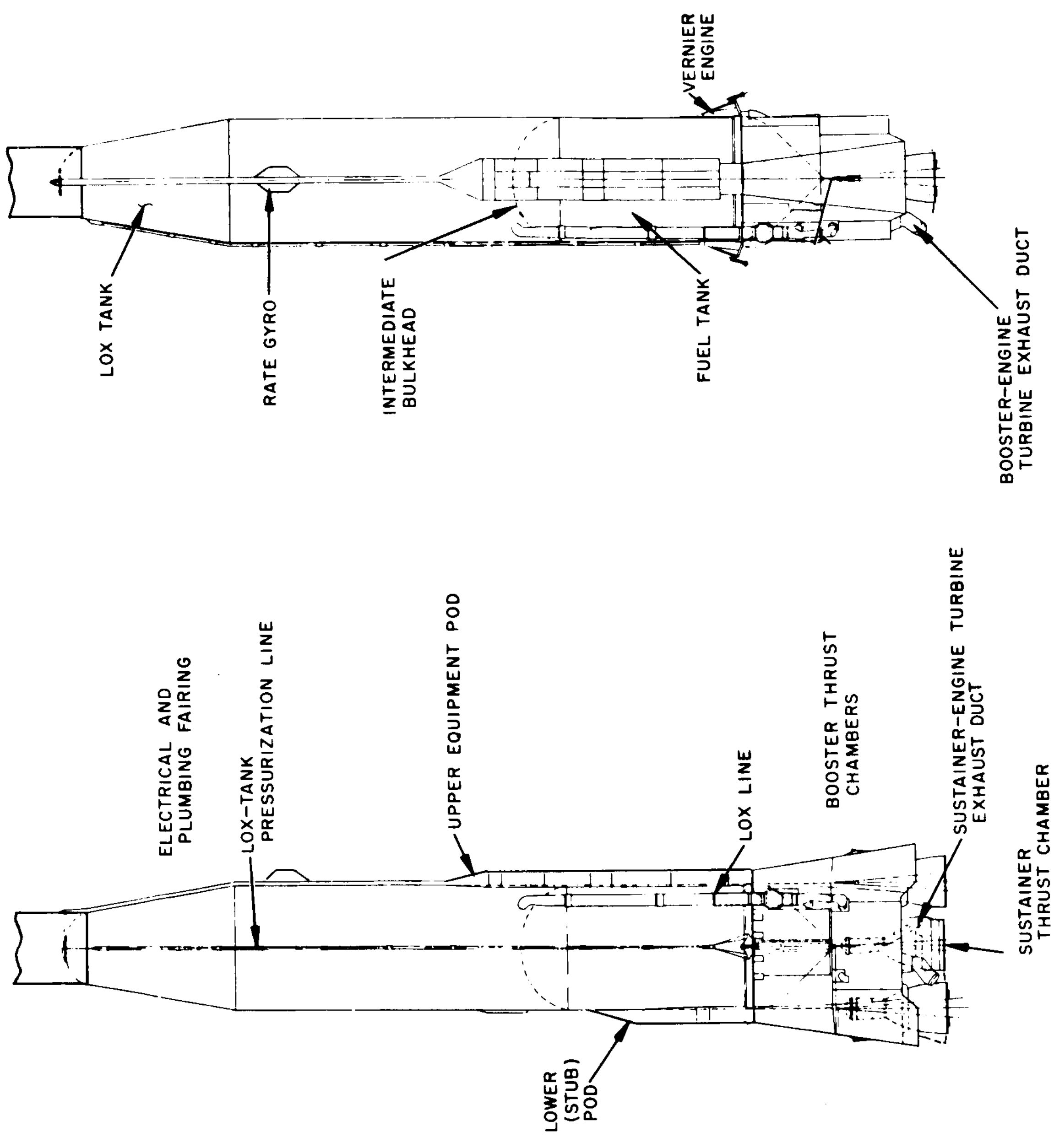


Figure 2. Atlas Launch Vehicle

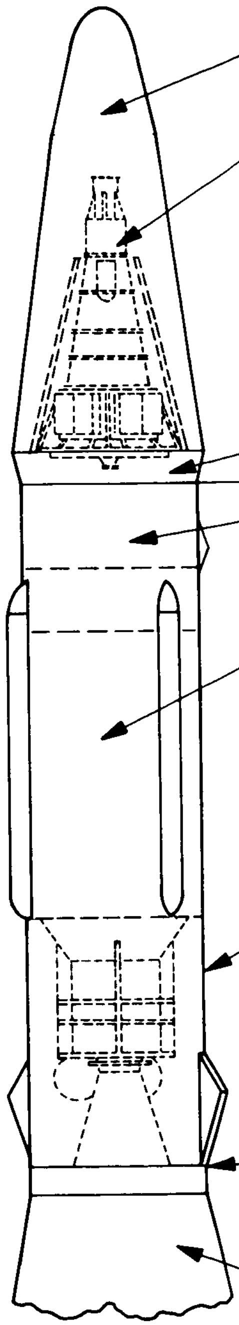


Figure 3. Agena Injection Vehicle

2. Plans for Launch-Vehicle Integration

JPL Specification 30331, issued on May 4, 1960, defined the spacecraft and system requirements necessary to effect interface design between the Ranger spacecraft and the Atlas/Agena launch vehicle. Definition of interface demarcation had already been agreed upon by JPL, MSFC, and Lockheed Missiles and Space Company (LMSC), and certain basic decisions had been reached on the interface equipment. Efforts were made to use existing designs and the design experience of LMSC. Some of the decisions were:

a. A monocoque shroud, which was to be ejected axially in a forward direction, would be utilized. This shroud was selected after consideration of the design, weight, fabrication, and contractual problems associated with an RF-transparent clam-shell shroud.

b. A spacecraft/Agena adapter section would be necessary to provide support for the spacecraft, since the spacecraft shroud had to be larger in diameter than the Agena, and since the spacecraft directional antenna required an extension in shroud length.

c. RF signals from the spacecraft would be monitored with the shroud in place through the use of antenna-coupler systems instead of hard-line, quick-disconnect systems.

d. Shroud ejection would be effected by the use of existing LMSC explosive-actuated pin-puller and spring devices.

e. To accomplish spacecraft sterilization, a sealing diaphragm and associated valving would be incorporated in the spacecraft/Agena adapter.

f. An Agena retro-system design was agreed upon which would prevent the unsterilized Agena from impacting the Moon.

g. The spacecraft would have a separate umbilical connector.

h. Agreement was reached concerning the launch-complex equipment to be employed.

The Agena B/Ranger spacecraft interface requirements are presented schematically in Fig. 4 and Fig. 5. Note that the external RF system is used for prelaunch checkout purposes only when the spacecraft is enclosed by the shroud. Failure coverage is provided from launch to shroud ejection through the omnicoupler system, and from launch to Agena/spacecraft separation through the modulation of a composite Agena telemetry signal.

Hardware developed for the mounting of the spacecraft on the Agena vehicle consisted primarily of an adapter (Fig. 6), on which the spacecraft and shroud are mounted; and the protective shroud (Fig. 7), which is ejected axially just before Atlas/Agena separation. This ejection would avoid the need for further acceleration of its weight. Following the end of the Agena second burn, the spacecraft would be injected into its trajectory, leaving the adapter with the Agena.

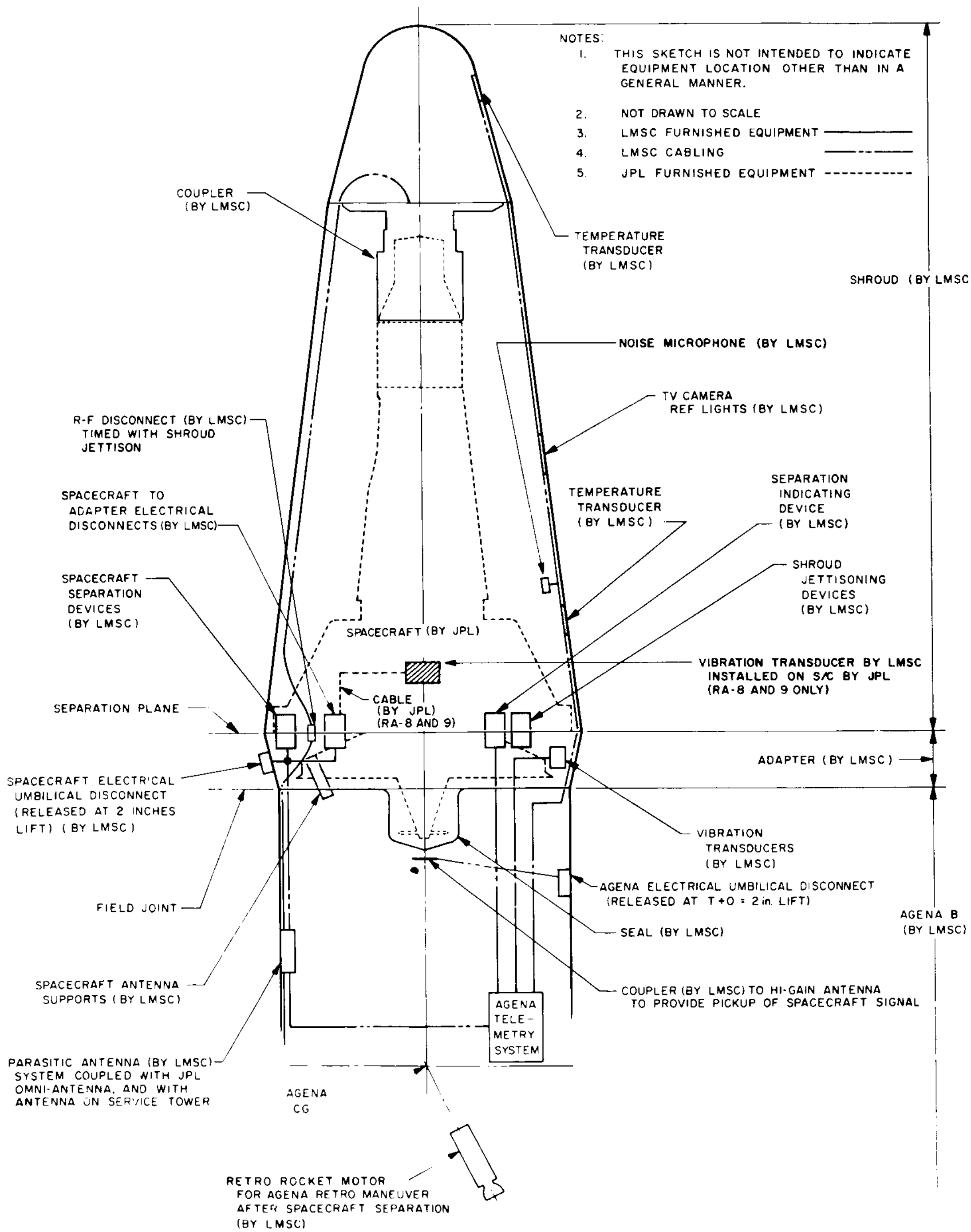


Figure 4. Ranger-Agena B Interface

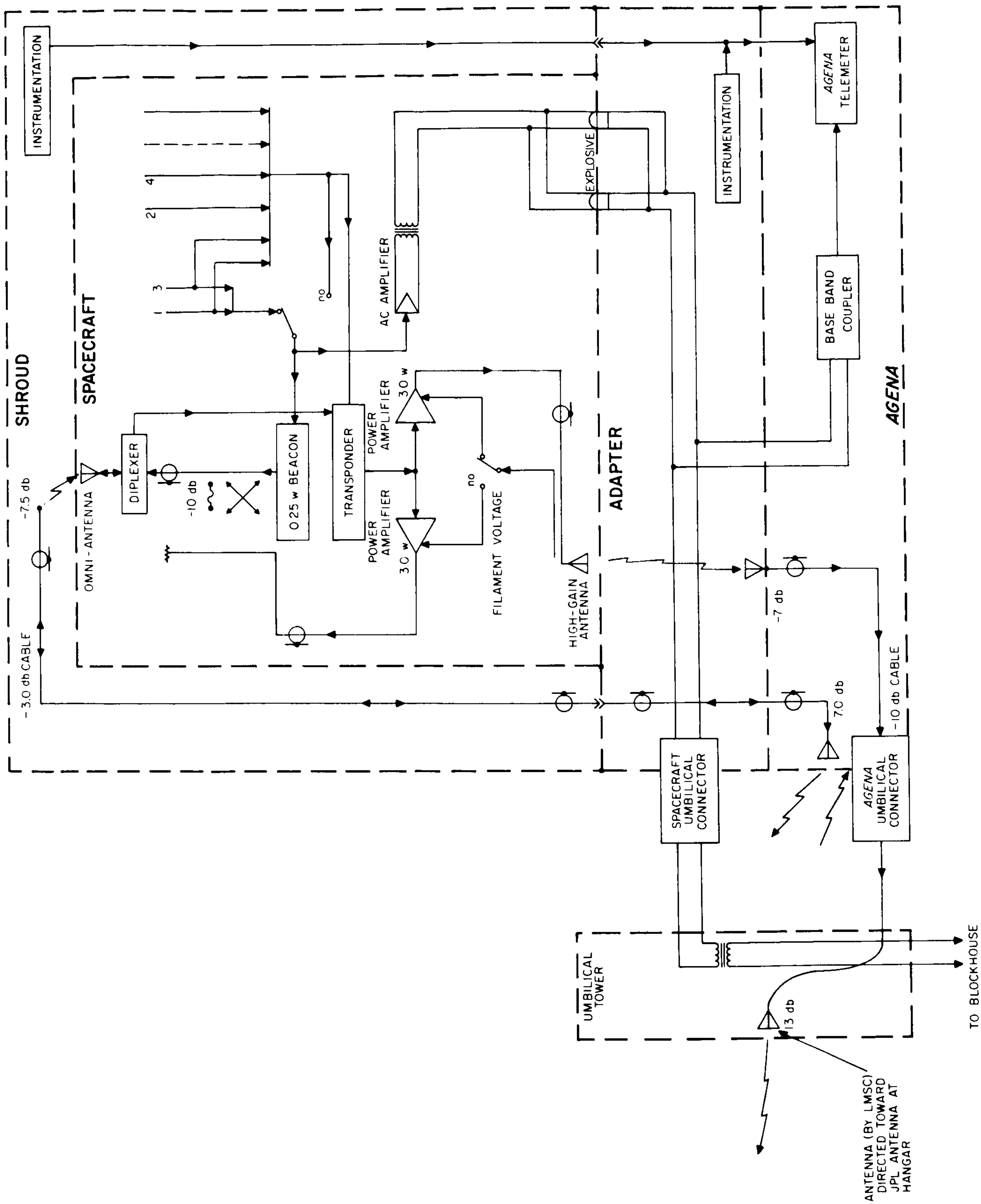


Figure 5. RF and Telemetry Interface

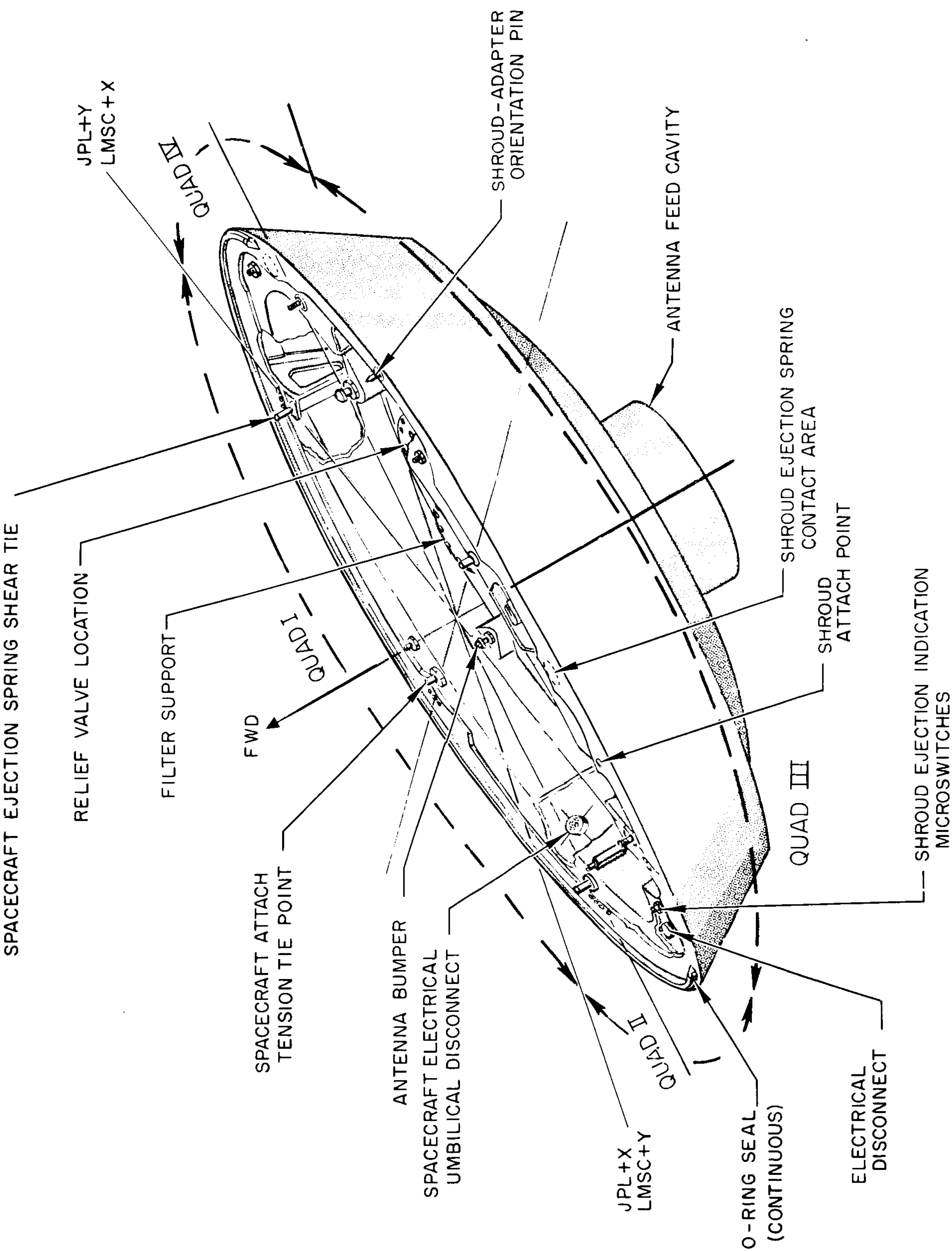


Figure 6. Spacecraft Adapter

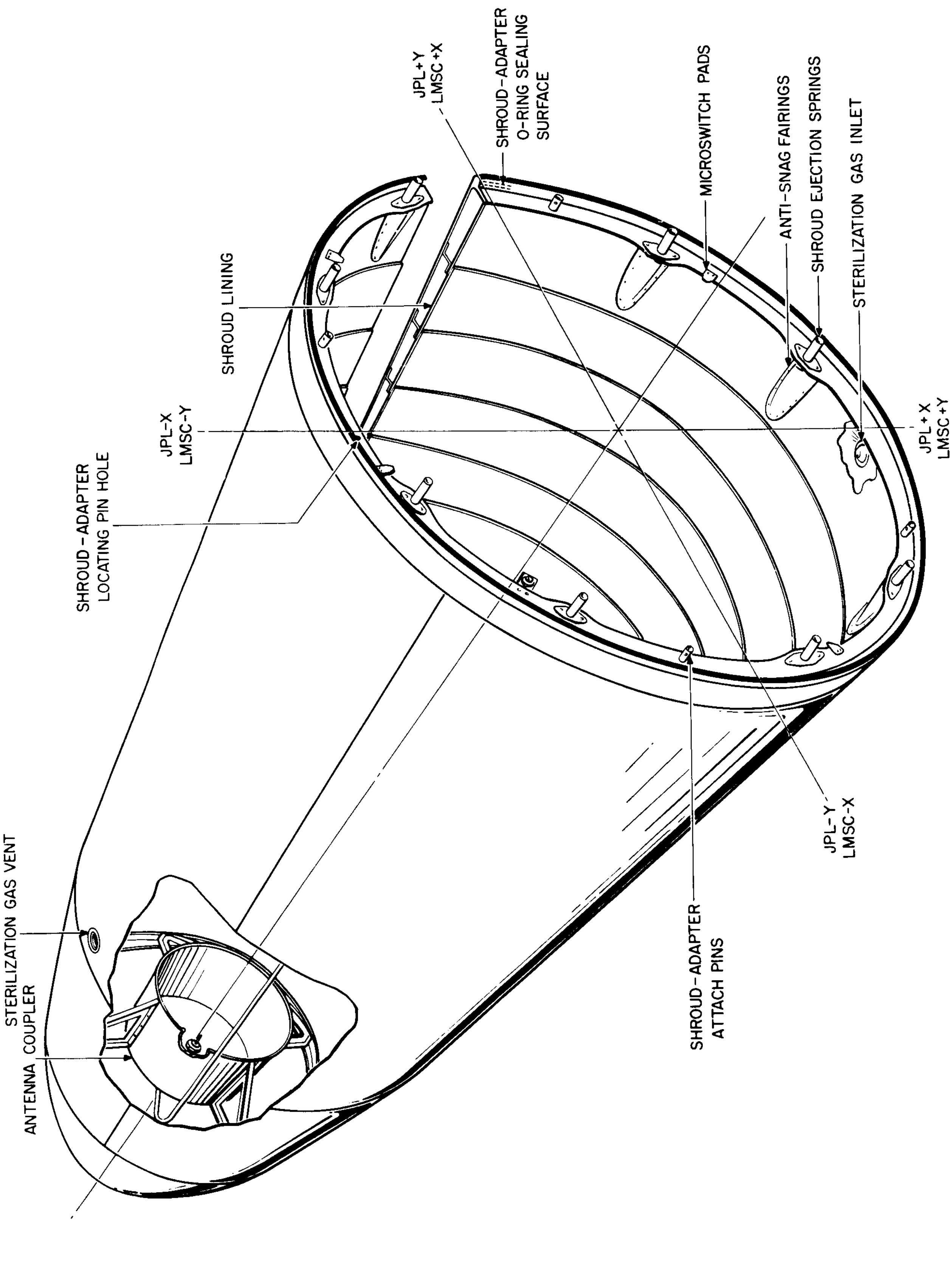


Figure 7. Spacecraft Nose Fairing

After spacecraft injection, it was planned that the Agena vehicle would perform a 180-deg yaw maneuver and a retrorocket would be fired to reduce its velocity in order to prevent the Agena from impacting the Moon.

LMSC made several presentations concerning the shroud and spacecraft separation mechanisms and dynamics. At these meetings, the final sequence of events from launch to Agena retromaneuver was developed, and a better understanding of the shroud and spacecraft separation dynamics was obtained.

A mockup of the adapter, shroud, and forward portion of the Agena vehicle structure, reworked from an earlier (1960) LMSC model, was received at JPL in January 1961. Plans for match-mate tests of the spacecraft and this equipment proceeded.

3. Launch-Vehicle System Description

The Atlas D/Agena B booster system was a 2-1/2 stage vehicle (Ref. 3), in which all Atlas engines were ignited and stabilized prior to commitment to launch. The single Agena engine was ignited twice in flight; first to accelerate the Agena spacecraft combination to the velocity required to attain a circular orbit about the Earth, and then, after a suitable coasting period in this "parking orbit," to accelerate the Agena/spacecraft combination to the injection velocity necessary to escape the Earth's gravitational field and coast to the Moon.

a. Planned Sequence for Atlas. The Atlas D was a 1-1/2 stage boost vehicle containing five rocket engines that used a kerosene-like hydrocarbon and liquid oxygen as propellants. At launch it had a thrust-to-weight ratio of approximately 1.25.

All five engines (two boosters, one sustainer, and two vernier engines) were ignited on the ground prior to liftoff to ensure maximum reliability. After most of the Atlas propellants had been consumed in flight, and before the vehicle acceleration attained 7 g, the two outboard booster engines were shut down and jettisoned; the vehicle continued on, powered primarily by the sustainer engine. When the required velocity for the Atlas portion of the flight had been achieved, the sustainer engine was shut down, and for a few seconds only the vernier engines provided thrust to stabilize the vehicle and to achieve the precision velocity desired. The verniers were then shut down, the Agena/spacecraft combination was separated from the Atlas, and the Atlas was backed away from the Agena by two small solid-propellant retrorockets.

From liftoff until after booster-engine jettison, the Atlas was guided by an onboard programmer and autopilot. For the rest of the Atlas portion of the powered flight, guidance was accomplished by a radio guidance system that sent correction signals to the autopilot, based on information obtained from a ground-based radar tracking station.

b. Planned Sequence for Agena. The Agena was a single-engine, dual-start, upper-stage vehicle utilizing unsymmetrical di-methyl hydrazine as fuel and inhibited red fuming nitric acid as oxidizer (Fig. 3). At first ignition, the Agena had a thrust-to-weight ratio of approximately unity. Its flight-control system consisted of a programmer, a reference gyro system, two horizon sensors, and a velocity meter. Elements of the flight-control system were preset on the ground prior to launch. A ground-calculated discrete command received via the Atlas radio-guidance system initiated the timing function for the Agena second burn; the Agena received no further guidance or control signals from the ground subsequent to separation from the Atlas. The programmer and the references provided the discrete events and the basic vehicle-attitude information during coasting and powered-flight phases. The horizon sensors viewed the Earth and updated the gyro information during flight to compensate for gyro drift. The velocity meter, preset for the required velocity-to-be-gained by the Agena stage, determined when the engine was to be shut down. The engine had to ignite twice in order to accelerate the spacecraft to the required injection conditions, after which it was shut down, and the spacecraft was separated from the Agena. After separation, the Agena executed a yaw maneuver of almost 180 deg and was decelerated by a small solid-propellant retrorocket to prevent it from impacting the Moon.

4. Interface Design Tests

Specifications and procedures for tests of the combined spacecraft/Agena systems were prepared during 1960. The moving of each major assembly for both tests and flight items was planned in detail (Fig. 8).

The tests relating to the Ranger/Agena systems interface which were conducted during the Block I portion of the Project (Ref. 4) indicated that the integration design was satisfactory for flight.

a. Serrated-Plate Shear Connections. The design of the shear attachment between the spacecraft and the adapter was investigated to determine whether to use a shear connection involving close-tolerance, tight-fitting bolts and holes (suggested JPL design), or a serrated-plate type (suggested LMSC design) which would permit some adjustment. The basic design could accommodate either method, and hardware was fabricated for both. Both designs were tested in the match-mate tests of Rangers I and II.

Structural tests indicated that the serrated plate type shear joint was satisfactory, and since it could be adjusted for varying tolerances, it was selected for use on all spacecraft.

b. Shroud Material-Qualification Smoke Tests. During March and April 1961, LMSC conducted qualitative tests to demonstrate the acceptability of the materials used inside the shroud. A number of the materials initially considered for this use were unacceptable because of the possibility of contaminating spacecraft surfaces by smoke or gases generated by aerodynamic heating. These materials were replaced by nonsmoking materials.

Results of the tests indicated that degradation of the reflective surfaces on the Lyman-alpha mirror would be on the order of 10%. This was comparable to variations resulting from the handling, storing, and testing of the samples and was considered satisfactory for Rangers I and II. All other tests of the JPL samples indicated satis-

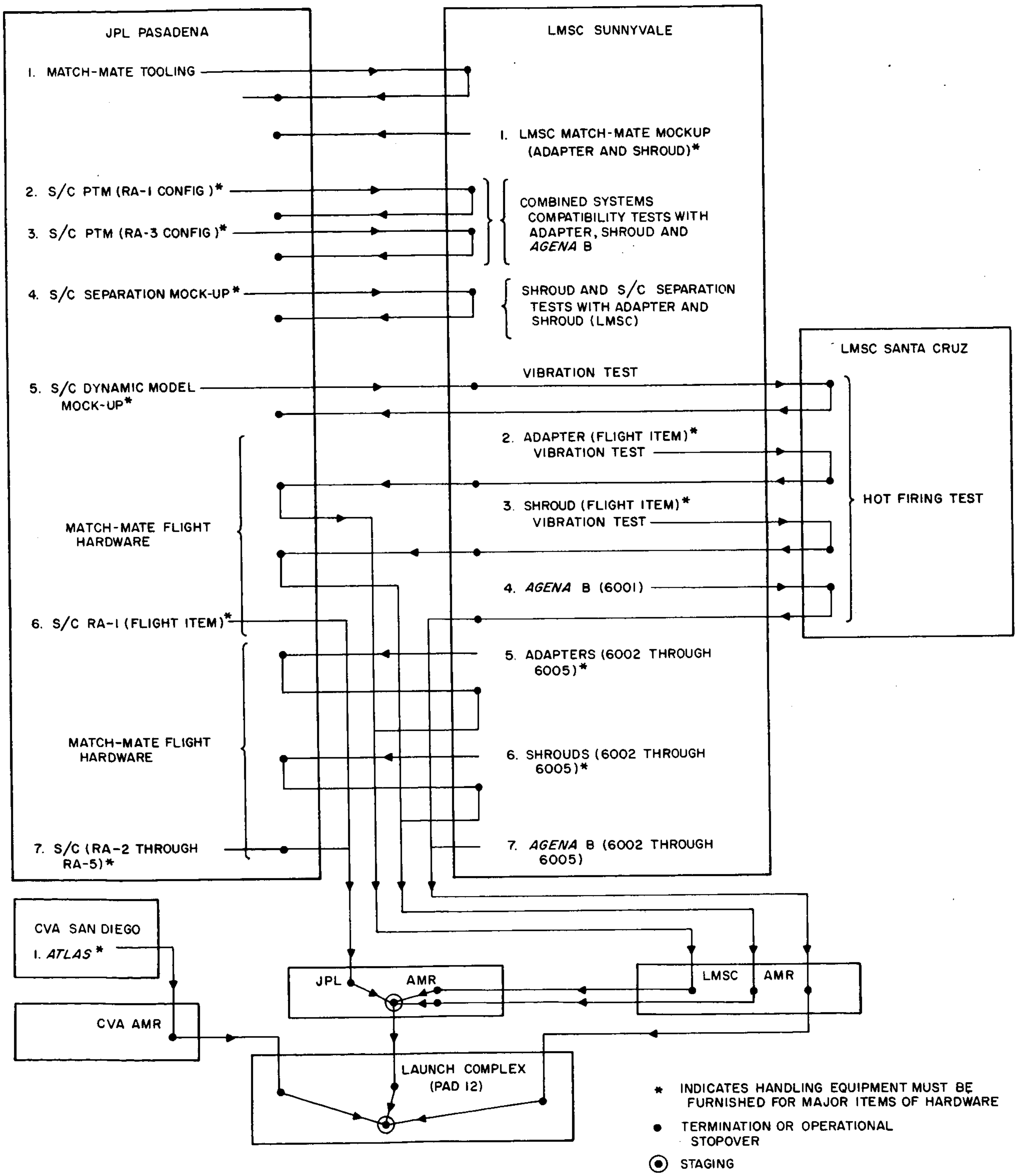


Figure 8. System Assemblies Flow Diagram

factory transmissibility in the visible light range.

c. Shroud Ground-Cooling Tests. A demonstration of ground cooling of the shroud under simulated spacecraft power dissipation was given at Lockheed (Van Nuys) in April 1961. A cooling blanket was fitted closely around the exterior contour of the shroud, and varying quantities of air at controlled temperatures were pumped through ducts to the blanket and distributed to annular ducts running around the shroud. Air flowing through the annular ducts picked up both solar heat from outside, and spacecraft-dissipated heat from inside the shroud and exhausted it to the atmosphere. The blanket was to be left on the shroud until the missile actually lifted off the pad. A cable attached to the umbilical tower would release the blanket along its entire fore and aft length, and, as the tower moved away from the missile, would pull the blanket with it. It was expected that a new blanket would be required for each flight because of the damage caused by the missile exhaust.

The weather was sufficiently cool to allow Ranger I to be launched without a cooling blanket. On Ranger II and subsequent flights, a cooling blanket was used with satisfactory results.

d. Vibration Tests. JPL furnished a dynamic model of the spacecraft to LMSC in April 1961 for running a composite vibration test of the Agena/spacecraft adapter, the spacecraft, and the shroud. The purpose of the tests was to check the structural compatibility of the assembly under simulated vehicle vibration.

The package was shaken in all three axes over a range of 6 cps to 6 kcps. Loads varied from 1 g at the low ranges to 7.5 g at the high range, with intermittent 0.5 g levels at particular table-resonance conditions. The test provided accelerometer data from each component - the shake table, the adapter, the spacecraft, and the shroud. Data was also obtained from distance probes on both spacecraft antennas to determine the extent of bumping or interference; results indicated that the package was structurally sound and that there was no interference. After the vibration tests were completed, the dynamic model of the spacecraft was sent to Lockheed's Santa Cruz test base for use in the Agena hot-firing tests.

e. Agena Hot-Firing Test. The hot-firing test was conducted in May 1961 on a spacecraft model instrumented with 12 accelerometers. All functions of the Agena were monitored, and a normal countdown was followed. Acoustical measurements were taken both inside and outside the shroud and data were obtained by use of both land-line and telemetered signals. Both the first and second burns of the Agena were of full duration. Results indicated that a working spacecraft would have survived the firing tests satisfactorily.

f. Shroud Separation Tests. Shroud-separation tests were conducted by LMSC at its Burbank facility. The adapter was mounted on a rigid steel framework, with the centerline of the spacecraft in a horizontal position. The spacecraft was attached to the adapter with flight pins, ejection springs, and pinpullers. The weight of the spacecraft was supported precisely at its center of gravity by means of a cable running to the building roof trusses approximately 65 feet above the floor. When the squibs in the pinpullers released the spacecraft, the springs ejected it away from the adapter. The precise movement was recorded by three high-speed motion-picture cameras aimed at selected portions of the spacecraft. Shroud-separation tests were run in a similar manner. The results of both tests indicated that no major difficulties would be encountered in actual flight.

g. Match-Mate Tests. Match-mate tests were conducted at JPL, using mockups of the adapter and the shroud, and a proof test model (PTM) of the spacecraft. Although no major difficulties were encountered, enough minor discrepancies were discovered to warrant match-mate tests of flight hardware prior to its shipment to AFETR for each mission.

h. Combined Systems-Compatibility Test. A combined systems compatibility test was conducted at LMSC, Sunnyvale, during the early part of 1961, with MSFC providing overall management direction. The purpose of the test was to demonstrate the mutual compatibility of the Ranger I PTM and the Agena B 6001 vehicle. The test was conducted in accordance with LMSC specifications and was divided into three major areas:

(1) The mechanical-compatibility tests were designed to go through, as completely as possible, the operations necessary to mate the spacecraft with the Agena shroud and adapter (Fig. 9), and to determine whether or not the ground handling equipment was compatible with the flight hardware. The tests included the following steps:

(a) The entire ground support equipment (GSE) complex was set up.

(b) The spacecraft was assembled and mated to the Agena adapter.

(c) The shroud was installed over the spacecraft.

(d) The spacecraft, adapter, and Agena were jointed.

(e) Complete RF-interference tests were made of the assembly, first with the shroud installed and then with the shroud removed.

Systems problems were uncovered, but they were primarily independent of the match-mating.

(2) The Electrical-compatibility test was performed to determine if the spacecraft/Agena adapter wiring was mutually compatible.

The spacecraft signals received via the Agena telemetry system were observed to have an 800 cps component which interfered with spacecraft Channel 3 (Figs. 10, 11, and 12). The tape made during the tests (Fig. 10) showed the Channel 3 signal on the spacecraft modulation line both before and after it had passed through the Agena (both at the same frequency). A dub of the recording of the

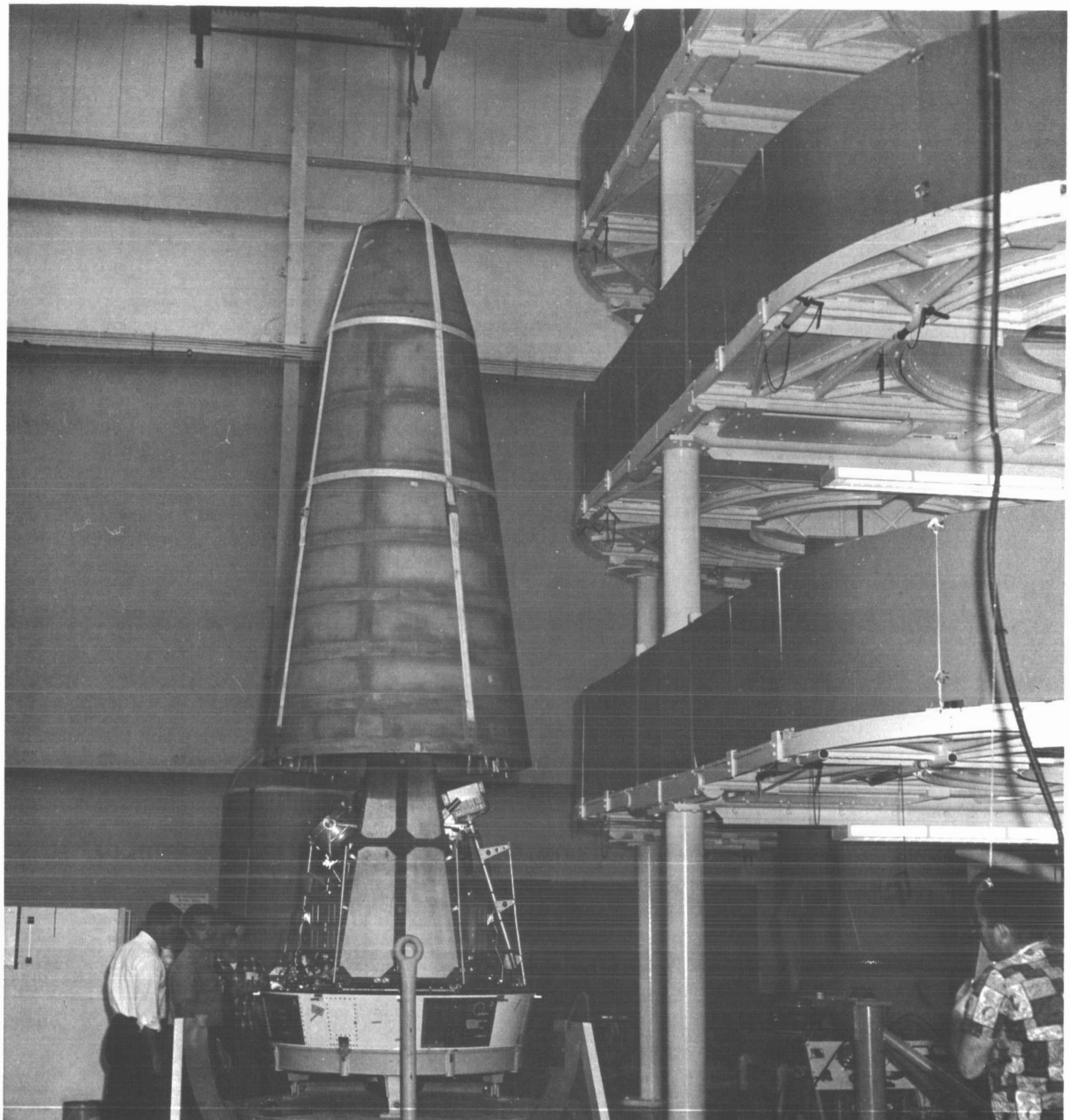


Figure 9. Installation of Nose Fairing

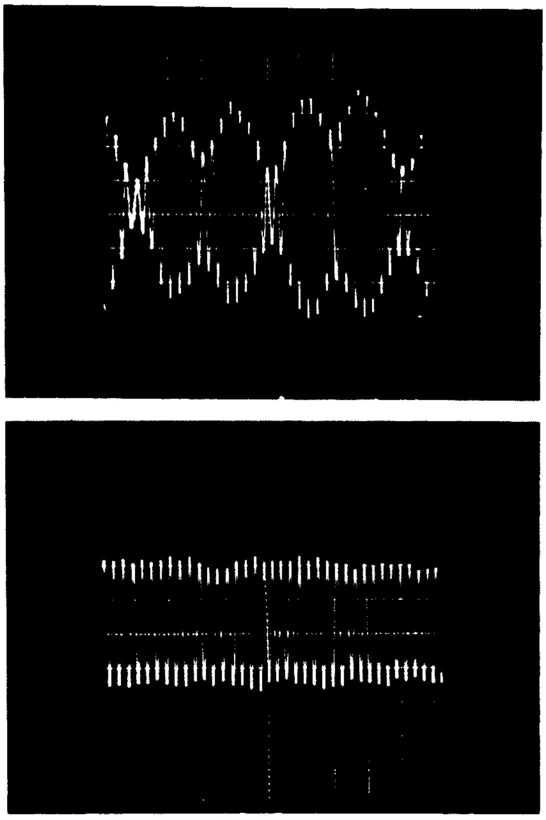


Figure 10. Channel 3 Output

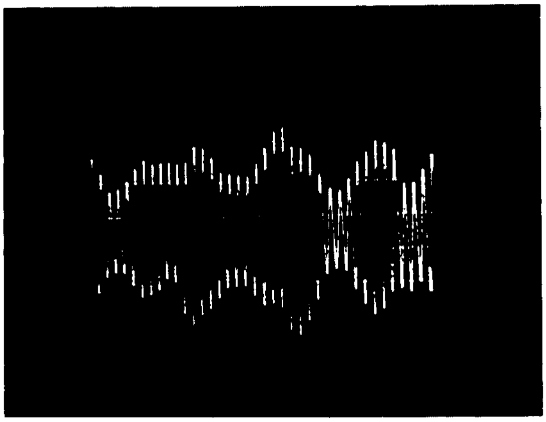


Figure 11. Channel 3 Output taken from LMSC Telemetry Tape

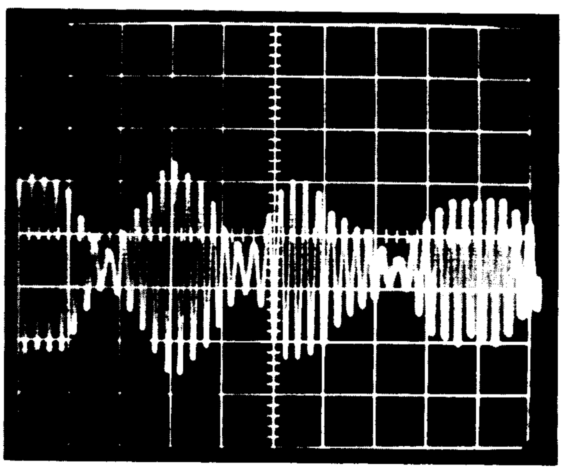


Figure 12. Channel 3 Output on Agena Telemetry Signal

Agena telemetry signal made by Lockheed during the test shows the same effect (Fig. 11).

It was determined that the 800-cps tone was not caused by the instrumentation gyro in the spacecraft. Thus, the Agena telemetry signal contains an 800-cps component which is 20 db greater than that in the spacecraft and only 6.5 db below the Channel 3 signal. (Results of the analysis of the spacecraft and Agena signals with an HP Model 302A wave analyzer are presented in Table II).

Another incompatibility (shown in Fig. 13) was an increase in amplitude which occurred regularly every 40 to 45 sec on Channel 1 of the Agena telemetry signal and nowhere else. This increase could have caused an error in the 400-cps timing reference used in the decommutator and hence, in the decommutation of the scientific data.

To resolve the 400 and 800 cps problems, LMSC performed an additional test utilizing a JPL-furnished magnetic tape to simulate the audio telemetry signal during an Agena 6001 systems test. When the reduced data failed to duplicate the incompatible components, attention was redirected toward the associated support equipment. The offending item was discovered to be a recorder.

(3) The RF-compatibility test was used to determine the RF compatibility between on-board electrical and electronic systems, and between on-board electronic systems and certain simulated AFETR sources.

During this test, the Agena and the spacecraft were simultaneously put through complete system-checkout runs while being exposed to a simulated RF environment. Three different system runs were made. The first run was accomplished without the shroud (Fig. 14); in the second, the shroud was installed but was removed manually (Fig. 15) at the time it is normally ejected during flight. During the third run, efforts were made to simulate flight conditions as nearly as possible. External monitoring cables were removed, and the preflight countdown was simulated. At "liftoff" the spacecraft and Agena umbilicals were removed, and a simulated flight sequence was conducted.

The RF environment equipment, designed to simulate AFETR conditions as nearly as possible, consisted of signal generators which fed directional antennas aimed at the spacecraft. JPL acted as overall coordinator for the environmental simulation. From approximately 24 hours prior to launch until the shroud was to be ejected during the boost phase of flight, the spacecraft would be completely enclosed in metal, i.e., the shroud, the adapter, and the Agena forward equipment rack. This indicated a fundamental incompatibility in that the antennas would not be radiating into free space; as a result, a large voltage standing wave ratio (VSWR) would develop within the RF system (Fig. 5).

Table II. Analysis of Spacecraft and Agena Signals

Signal	Spacecraft Signal, db	Agena Signal, db
Channel 1	-12	-12
Channel 2	0	0
Channel 3	-7	-6.5
Channel 4	0	0
800 cps	-33	-13

(4) Further tests were made at JPL with the Ranger RA-1 PTM and previously-supplied mock-ups of the adapter, shroud, and Agena forward equipment rack. (These mock-ups were considered to be reasonable approximations of the flight hardware.) The results of these additional tests are as follows: (a) With a signal generator serving as the RF power source, the results essentially duplicated those of the original LMSD laboratory tests. (b) With the Ranger RA-1 PTM as the RF source, the results duplicated those obtained during the combined systems compatibility test.

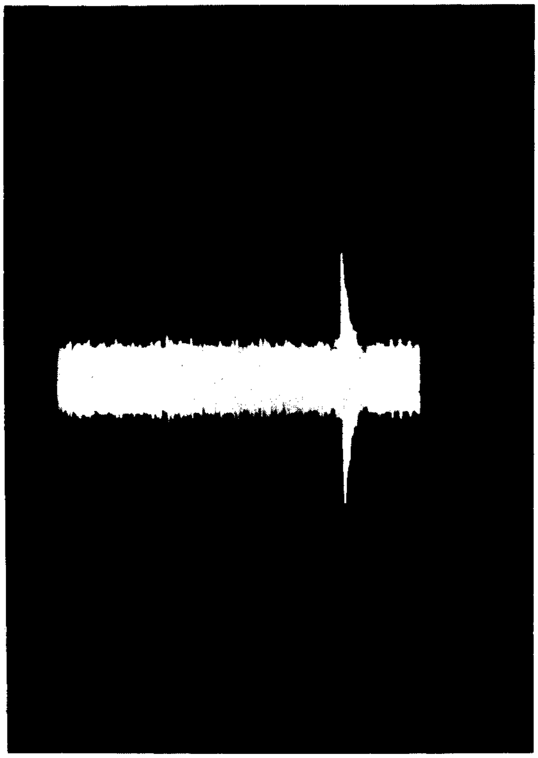


Figure 13. Channel 1 Amplitude Change

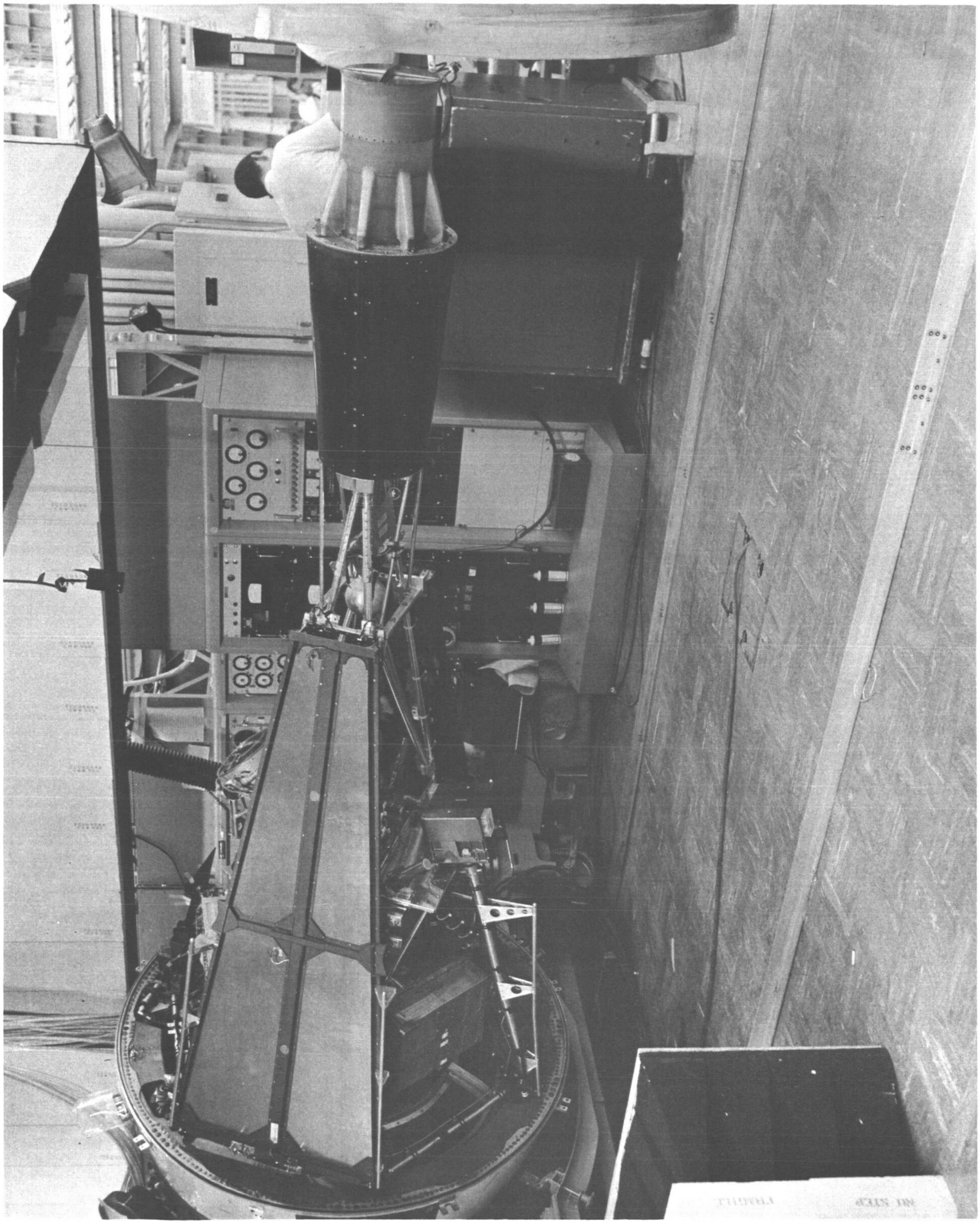


Figure 14. Spacecraft Mated to Agena

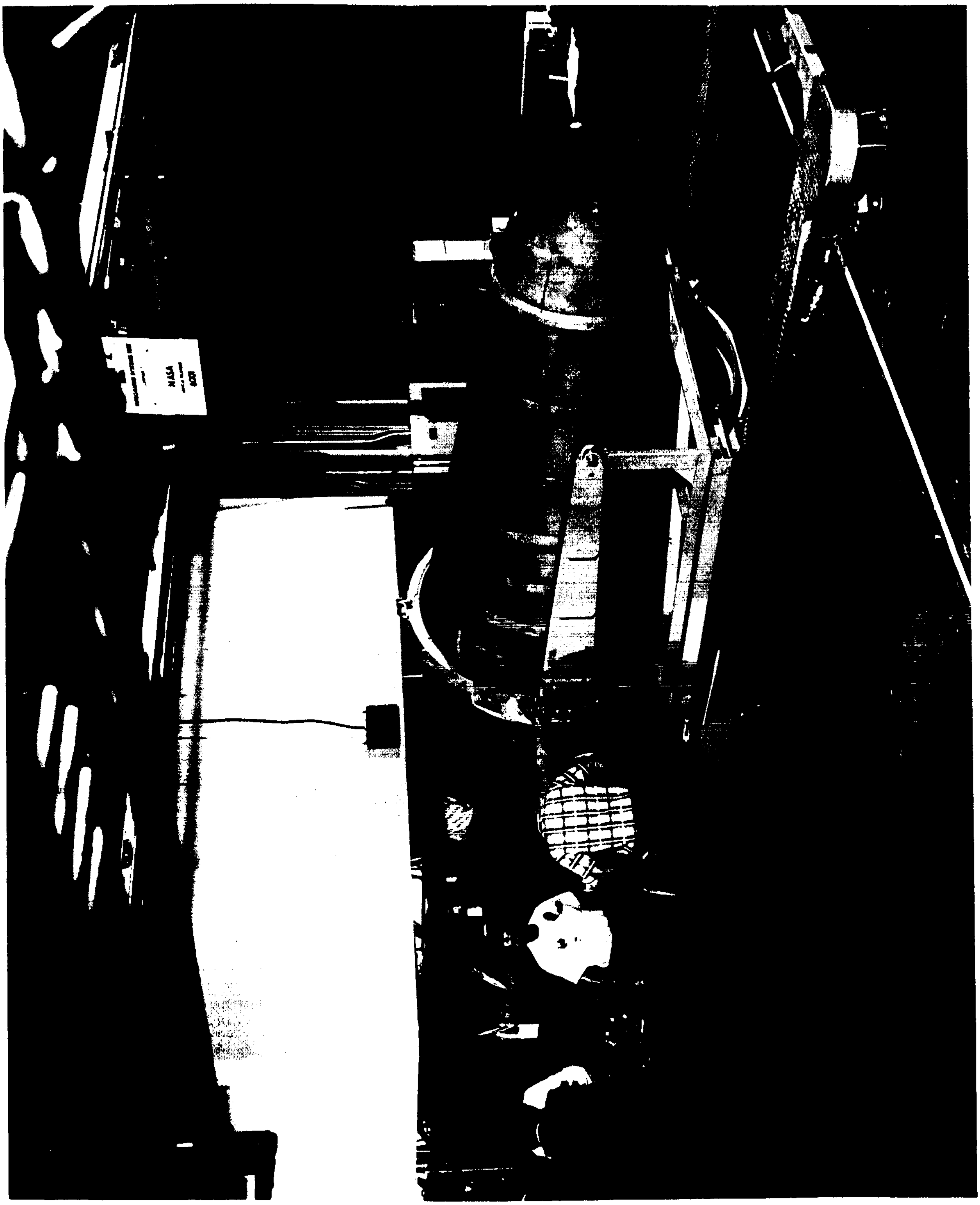


Figure 15. Spacecraft-Adapter-Nose Fairing Assembly

As shown in Fig. 5, the spacecraft had three RF cavities which provided the RF power output through coaxial cables, two at 3.0 w and one at 0.25 w. The feasibility of coupling a portion of this RF energy from the antennas to the exterior of the vehicle was established by MSFC, and the system design parameters were specified by JPL. Thus, two-way communication links were provided through an integrated RF system.

The combined systems-compatibility test showed degraded performance through the integrated RF system, especially (as compared to the original laboratory tests) through the high-gain-antenna coupler system. The power output through the omniantenna to the parasitic-antenna system was 5 db less than anticipated. It was 13 db less than anticipated through the high-gain-antenna Agena umbilical connector system. (Values shown in Fig. 5 are the anticipated values.)

It was established that the large VSWR in the spacecraft coaxial cables (which is the load seen by the RF cavities) was degrading the performance of the RF cavities. The mismatch detuned the cavity, with resultant reduction in power output and the detuning caused a large and presumably detrimental increase in the plate current.* The performance of the Lockheed-designed and installed RF couplers was not degraded. The mismatch was alleviated by changing the length of the spacecraft coaxial cables so that each RF cavity would experience as little mismatch as possible.

The objectives of the mechanical, electrical, and RF-interference tests were met. A number of minor problems were resolved during the course of the test, and two incompatibilities, one RF and one electrical, were uncovered which required corrective action.

5. Ranger I Launch Preparations

The Ranger I spacecraft, Agena 6001, and Atlas 111D successfully passed a joint flight-acceptance composite test (J-FACT) on July 13, 1961. The spacecraft was then returned to the hangar for final preparation and system test, while the Agena and Atlas completed a flight-readiness demonstration (FRD) test. The desired launch period was July 26 through August 2, with a daily firing-time window extending from 0453 to 0537 EST. Because of launch-complex electrical problems, the FRD took place one day late; this slippage, together with a no-go indication from range safety, forced a day postponement of the first countdown. An additional day was lost because of spurious discrete command indications in

*Later, it was determined from laboratory tests that the large plate current was not detrimental since only the low-power mode of the cavities is used until T + 22 min when the transponder power is turned up. (The shroud is ejected at T + 297 sec).

the GE guidance system of the Atlas and an incompatibility in the guidance program which could not be immediately resolved. Since the necessary computer was not available, the countdown was postponed still another day.

On the fourth day of the desired 8-day period, the first countdown took place. During the countdown, it was necessary to replace an Agena inverter and to dry out some wet umbilicals; also, some operations took more time than scheduled, so that the planned hold times were used up. Nevertheless, the operation was normal until T minus 83 min when a momentary power interruption caused a hold to be called to permit all stations to check and recover from its effects. During the next hour, several more electric-power dropouts occurred, and much of the equipment was transferred to standby sources. At T minus 28 min, both industrial and Cape critical power failed; 12 min later, the launch was cancelled.

The next launch attempt was scheduled for July 31. Early in the countdown, the pressure in the spacecraft attitude-control nitrogen tank was found to be lower than it had been 2 days before. The count continued while the leak rate was confirmed, and a T minus 231 min, the launch attempt was scrubbed. The spacecraft was returned to the hangar, the shroud was removed and the faulty component replaced, and flight status was regained in time to begin counting for a launch on August 1.

The third countdown began well but slight abnormalities were observed in the behavior of the spacecraft. At T minus 15 min a helium leak in the Agena GSE had to be corrected. For the safety of personnel, the liquid oxygen (LOX) was emptied before the helium leak could be stopped. When retanking was attempted, a LOX GSE valve malfunctioned and could not be repaired before the launch time interval ran out.

A fourth attempt was planned for August 2, the final day of the launch period. Early in the count, spacecraft controller Command 2 was turned on by ground control for calibration. Immediately all stations reported a major spacecraft failure, and the count was terminated. When the spacecraft was returned to the hangar and the shroud removed, it was apparent that all, or nearly all, of the ten controller commands had been erroneously issued. All 22 squibs aboard had fired, releasing the solar panels, solar-corpuscular experiment boom, and Lyman-alpha telescope. The high-gain antenna was extended (its mechanism was undamaged, being protected by a slip clutch), and the friction experiment was running.

The expended components were quickly replaced, and the spacecraft, which had suffered no damage, was restored to its original status. Since the cause of the malfunction was not isolated in time for another countdown, the launch attempt was abandoned until one lunar month later.

The period between the last attempted launching on August 1 and the actual launching on August 23 was utilized to investigate the malfunctions that had occurred during the previous countdown, to modify the spacecraft in order to prevent similar occurrences, and to verify spacecraft-system readiness prior to going to the launching pad. The investigation resulted primarily in a modification of the spacecraft and adapter wiring to provide a lockout circuit for the controller commands until separation from the Agena.

The spacecraft, shroud, and adapter were moved to the launching pad on August 21 and installed on the vehicle. The final countdown started at 19:27 EST, August 22 resulting in liftoff 22 min 10.26 sec after the start of the 63-min launch window.

On August 23 at 05:04:10.26 EST, the Ranger I was launched from AFETR (Ref. 5). Vehicle performance through the parking-orbit phase was normal, however, a malfunction in the Agena B propulsion system prevented the Agena second burn, thus leaving the second stage and spacecraft in a slightly modified parking orbit.

6. Ranger II Launch Preparations

The Ranger II spacecraft, the Agena 6002, and the Atlas 117D were mated for flight for October 18, 1961. When the spacecraft power was turned on for on-pad checks, a malfunction in the telemetry encoder was noted which resulted in the loss of two binary data channels. The spacecraft was returned to the hangar, where the defective module was replaced and the spacecraft remated in time for the first scheduled launch attempt on October 19. The countdown progressed smoothly until T minus 45 min, when an electrical malfunction was discovered in the Atlas and the count was terminated. The trouble was later traced to a faulty cable splice.

The flight was rescheduled for October 22 but was postponed to October 23 when it was decided to replace some components in an effort to reduce the magnetic field at the magnetometer. During this period, components of the Lyman-alpha experiment were also exchanged in order to remove a source of intermittent noise.

The second countdown again proceeded smoothly to about T minus 40 min, when another cancellation was required because of a leak in the Atlas vernier-engine hydraulic system.

The next launch attempt could not be scheduled until October 25 because of time requirements for the Atlas vernier repair and interference of other projects on the Range. Preparations for the countdown had started when word was received from Lockheed that the Agena could not be cleared for launch because of the inflight failure of a Discoverer on the previous day, traced to abnormal drops in the hydraulic system pressure, which finally resulted in the loss of engine gimbal control.

Ranger II was launched on November 18, after an unusually smooth countdown; the only delays were for corrections of minor difficulties in the Agena umbilicals and in the Atlas LOX-tanking measurement.

The Atlas performance was completely satisfactory, despite a minor error in staging time, and the Agena first burn (to acquire parking-orbit speed) took place on schedule. The second burn did not occur. As in the case of Ranger I, the spacecraft was left in a low Earth orbit (Fig. 16) instead of in the desired near-escape trajectory. Agena telemetry records showed that the cause of the Ranger II failure was entirely different from that of Ranger I. On Ranger II, the Agena roll gyro was inoperative throughout the flight. With no roll control, the Agena depleted its attitude-control gas supply shortly after the first burn, and was tumbling at the time of the second burn. The second-burn start sequence began on schedule; the engine ignited but immediately shut down, probably as a result of gas ingestion caused

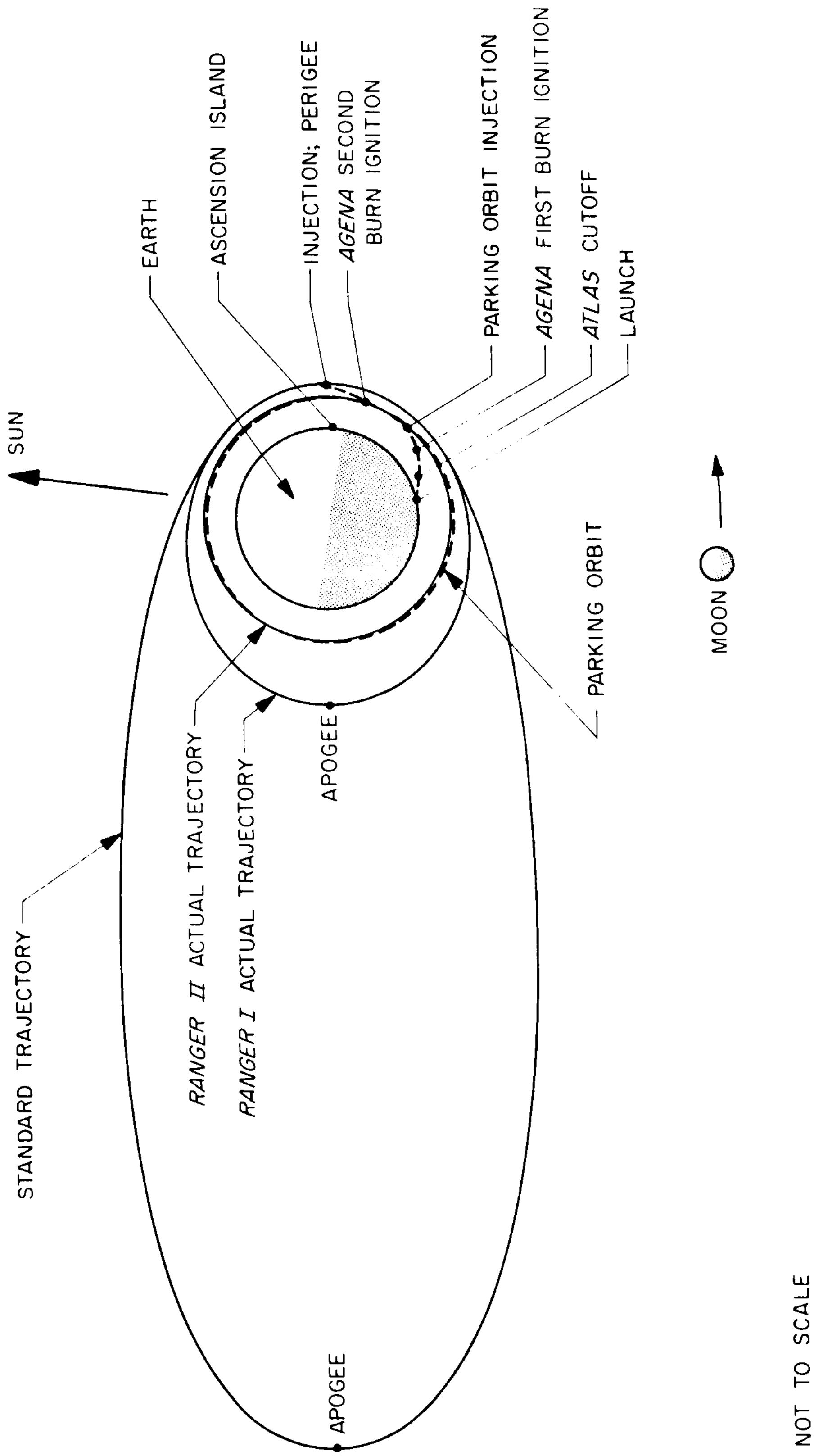


Figure 16. Orbits of Rangers I and II

by the tumbling motion.

7. Interface Design

The flights of Rangers I and II demonstrated that the design of interface equipment was satisfactory, in that

(a) design requirements for spacecraft communications through the coupler systems were achieved,

(b) design requirements for shroud and spacecraft ejection were met, and

(c) the shroud and adapter furnished protection against all the environmental conditions of the launch phase.

The results of these flights, as well as the results of the interface tests, provided a high level of confidence in the interface-equipment design.

B. RANGER BLOCK II

1. Compatibility and Match-Mate Tests

The desirability of again conducting a combined systems-compatibility test, which would involve the mating of the Ranger III PTM and the Agena 6003 vehicle, was evaluated in June 1961. It was decided that such a test would not be necessary, and that only integration design-verification tests would be scheduled.

The integration design-verification tests were performed at JPL from July 28 to August 3, 1961. The only significant change between the Ranger I and III interface was in the type and location of the omniantenna. This was the primary reason for making the tests.

The match-mate tests for Ranger Block II were performed in essentially the same manner as for Block I, prior to shipment of the hardware for each spacecraft to the launch site. Constant planning was necessary to schedule match-mate tests so they would fit into the master schedules of both LMSC and JPL.

Match-mate tests of the Ranger III spacecraft with the flight adapter and nose fairing were accomplished at JPL from October 25 to 27, 1961. The list of action items which evolved from these tests mainly involved cabling, cable connectors, and pins; two of the items, however, concerned shroud-installation procedures.

Match-mate tests for Ranger IV were partially accomplished from January 3 to 5, 1962, at JPL. The tests were limited in scope by the fact that only the flight adapter was available. (The flight shroud was not shipped to JPL because angle-of-attack instrumentation was being installed at LMSC.) It was planned to make complete match-mate and RF checks at AFETR, beginning about the middle of February 1962.

The electrical-harness pin-to-pin checkout, tests of the connection of spinoff plugs and umbilical connector, and the mating of spacecraft to adapter were performed as scheduled.

The RF portion of the tests could not be performed because of the missing shroud; however, a spacecraft functional checkout, release, and simulated squib firing were successfully completed.

As had been planned, the match-mating of the Ranger IV flight hardware, including spacecraft, adapter, and shroud, was satisfactorily completed at AFETR on March 8 and 9, 1962.

Match-mate tests of the Ranger V spacecraft using the flight adapter and shroud were accomplished at JPL from July 13 to 15, 1962. Inadequate cabling was again a problem. A marginal clearance was noted between the shroud and high-gain-antenna-actuating gear box.

2. Interface Documentation

The JPL launch-vehicle/spacecraft interface document for Ranger, JPL Detail Specification 30331, was revised twice (C and D revisions) during Block II operations. This was a classified document which had been written for Rangers I through V and which had been revised twice before (A and B revisions) during the Block I operations. Final requirements for Block II were described in the "D" revision, dated December 21, 1961.

Operational support equipment (OSE) requirements were described in JPL Design Specification 30583, published on March 8, 1962. Specifically, the requirements for mechanical and electrical support equipment on Launch Complex 12 at AFETR were covered by this document.

3. Countdown and Launch

The risks of the Block II missions were accented by failures of Rangers I and II. Nevertheless, preparations for the launch of Ranger III remained on schedule. Ranger III, Agena 6003, and Atlas 121D successfully completed a joint flight-acceptance and compatibility test on January 5, 1962 at AFETR.

Preflight activities continued on schedule until January 19, 1962, when, during Atlas fueling, the fuel-tank insulation bulkhead failed. At first it appeared that the mission would have to be postponed until the February lunar opportunity, but Atlas personnel, working around the clock, made an ingenious and unprecedented repair without removing the vehicle from the pad. The flight was rescheduled for January 26, and the spacecraft TV camera was adjusted so that January 27 could also be used as a launch date if necessary.

Ranger III was launched from AFETR on January 26, 1962. A failure in the Atlas ground guidance system resulted in a late booster cutoff and in a loss of control over the sustainer cutoff time which made it impossible to compensate for the excess velocity accumulated. Two programmed Agena burning periods followed, and the spacecraft was injected into an orbit in which it could intercept the Moon. The excess injection energy was too great for correction by the midcourse propulsion system, so that the possibility of a successful lunar impact mission was ruled out early in the flight.

The Ranger IV launch countdown proceeded normally, although minor holds were called because of difficulties with the Atlas umbilical plugs and the GE guidance system.

Ranger IV lifted off from Complex 12, AFETR, on April 23, 1962. The spacecraft impacted the Moon 63 hr 59 min later. Launch-vehicle performance was flawless and all range operations went according to plan. The spacecraft, which was functioning normally from launch through injection, failed some time before South African (mobile tracking station, DSIF 1) acquisition and from that time on did not execute any programmed functions or respond to any commands. DSIF tracked the spacecraft transponder until battery depletion 10 1/2 hr after liftoff, and tracked the capsule transmitter from that point to the Moon.

The Ranger flight series was interrupted during the summer of 1962 to allow for the launching of two Mariner flights. Between the arrival of the Ranger V spacecraft at AFETR on August 27, 1962, and the Ranger V launch on October 18, 1962, all spacecraft preparation activities (prelaunch checkouts and final launch countdown) took place within the anticipated operation and launch schedule. Launch, initially rescheduled for October 17, was postponed until October 18, due to Hurricane Ella.

The Ranger V spacecraft was launched from Cape Kennedy on October 18, 1962, after a smooth countdown, in spite of high surface winds. The performance of the Atlas/Agena B launch vehicle was near nominal, and the spacecraft was injected over the Indian Ocean 35 min, 39 sec after launch (Fig. 17). The injection conditions were well within the nominal guidance dispersion region, so that approximately 40% of the spacecraft's midcourse correction capability would have been required to obtain a lunar impact in the target area if the spacecraft had performed properly. The attempted midcourse maneuver was not successful; however, the spacecraft's trajectory carried it past the west, or trailing edge, of the Moon at 8 deg below the lunar equator, with an altitude at closest approach of 452 mi at 70.9 hr after liftoff.

4. Launch-Vehicle Interface

The integrity of interface design was again verified by the results of all the Ranger flights in Block II, and other problems in the launch-vehicle area became better identified. Enough flights had occurred, both in the Ranger program and in others, to provide a statistical base for establishing definite long-term performance and reliability characteristics. Continuing efforts were made to improve these characteristics.

C. RANGER BLOCK III

After the flight of Ranger V, activities in the Ranger Block III program were marked by sharply increased management activity. Key personnel in the project were given new and different assignments, responsibilities of launch-vehicle agencies within the NASA structure changed hands, and efforts of technical personnel were concentrated on what was described as a critical point in the Ranger program.

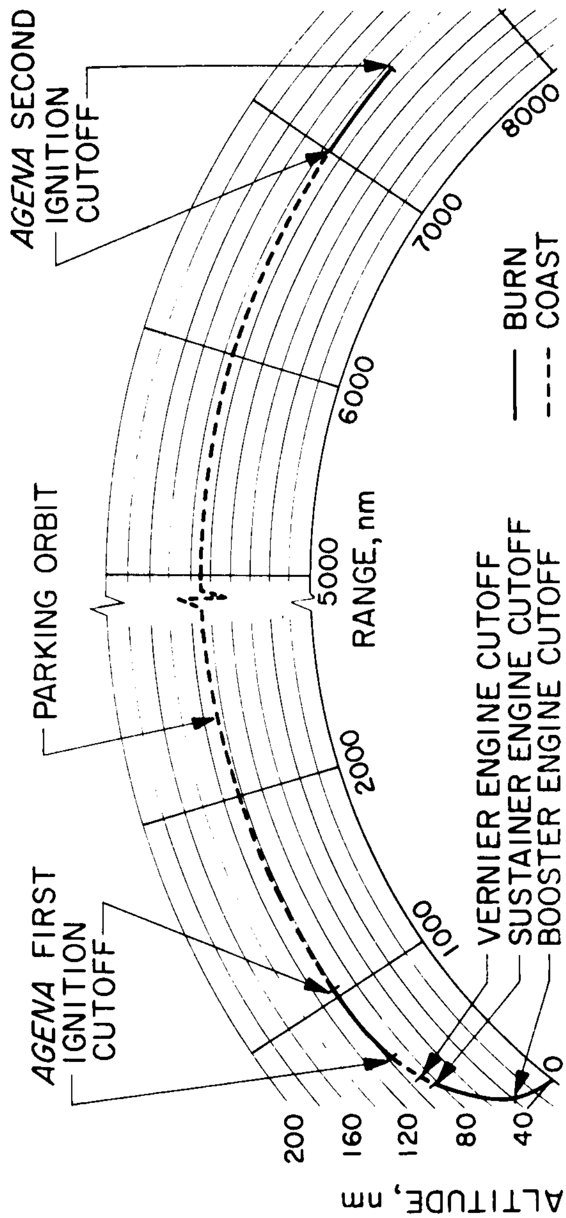


Figure 17. Typical Ascent Trajectory Profile

Major inflight failures had been experienced with the Atlas/Agena and spacecraft systems in six out of the seven lunar and planetary flights attempted through Ranger V. Furthermore, the launch-vehicle equipment failures and other problems which had been encountered during prelaunch activities remained at an undesirably high level despite the many efforts put forth to improve reliability in the system. The Ranger Project Office, therefore, in addition to reviewing the spacecraft system, initiated action to extend the efforts toward obtaining this increased reliability of the launch-vehicle system in view of the short time remaining before the Block III flights were to begin.

Shortly after the Ranger V launch, when at that time a tentative one-month slip in the Ranger VI launch was being considered, the Agena B Systems Manager, the Marshall Space Flight Center, was asked in a number of communiques to revise the current plan for vehicle-reliability improvement actions so as to exploit fully the extra time period. The need for additional efforts in certain specific critical areas was outlined.

1. Change in NASA Cognizant Agency

During the month of January, 1963, NASA management of the Atlas/Agena launch vehicle system was transferred from the Marshall Space Flight Center, Huntsville, Alabama, to the Lewis Research Center (LeRC), Cleveland, Ohio. On January 10, 1963, Ranger project representatives along with other people from the Laboratory held an initial meeting in Cleveland with key Lewis people who had been assigned to handle the Agena Project. JPL representatives reviewed the Ranger and Mariner projects, including past performance results of the launch-vehicle system; and discussed at length the major areas of concern relative to vehicle reliability.

2. Coordination of Plans

Intense efforts were made by JPL to determine the feasibility of immediate launch-vehicle improvements.

a. A coordination meeting was held at JPL on January 23 to 24, 1963, in which representatives from NASA Headquarters, MSFC, LeRC, SSD, and JPL took part (Ref. 6). Discussions were carried on concerning the results of the Ranger spacecraft design reviews. It was decided that more redundancy was to be incorporated in some spacecraft subsystems, and some spacecraft structural elements were to be strengthened. Both of these changes contributed toward an increase in the spacecraft weight to a total value lying between 800 and 825 lb; consequently, ways were sought to increase the vehicle boost capabilities and to improve the efficiency and reliability of the existing design. A list of action items for the various agencies evolved from this meeting.

The basic objective of the meeting was to decide upon proposals to maximize the probability of mission success. Previously, on December 21, 1962, JPL had requested MSFC, by letter, to determine what Agena performance improvements could be implemented in sufficient time to support the next Ranger launch, assuming there would be no sterilization requirement - thermal or terminal. At this meeting, the MSFC evaluation of the LMSC letter (A340683/91-21) was presented in response to this request. MSFC believed that the Agena inert weight could be reduced by 25 lb by saving 28 in the adapter, and 7 by using the light-weight "C" band beacon. If more improvements were required, some of the Atlas improvements, which had been previously evaluated for the Mariner R requirements, could be implemented in time for the Ranger launches in 1963. These were enumerated as follows:

Atlas Performance Characteristic		Performance Improvement (lb)
(1)	Use light-weight telemetry	7
(2)	Optimize pitch program further	10
(3)	Reduce parking-orbit altitude from 100 to 92 nautical miles	13
(4)	Use booster steering	20
	Total	50

Therefore, a total of 85 lb more of launch-vehicle injection capability could be made available if JPL were to require it. An analysis was made of the order in which Agena vehicles 6006 through 6009 should be utilized to conduct the next three Ranger launches, considering their present degree of completion, the number of changes required, and lead times for hardware. All work on Agena 6009 had been stopped, pending reprogramming decisions. Economic considerations were to be included by MSFC in their recommendations, and LMSC was to provide new performance figures for preferred vehicle utilization as soon as NASA approved the new launch schedule. JPL, in keeping with the then-current spacecraft-design philosophy, felt that every possible effort should be made to provide vehicles of identical configuration for each block of planned launches. MSFC recommended replacing the Agena B with an Agena D in order to use Agena D s exclusively in the Ranger 1964 series.

JPL's letter of December 21, 1962 was followed by another letter in which, taking into consideration the substantial delay in the launching of the next Ranger, JPL had requested MSFC to incorporate changes in both the Atlas and the Agena that would increase the reliability of these vehicles. On January 15, 1963, MSFC had responded with a plan of action, and this plan was restated at the meeting. JPL again stressed that, with a delay in launch schedule of nine months, a considerable time period was now available to accomplish some of the major reliability actions already recognized and proposed by other agencies, notably in the GE guidance area. A major portion of the recommended requalification test program could be accomplished prior to the next launch, and new airborne equipment could be installed on the Atlas for that launch. JPL suggested that vehicles for the next Ranger flights - in particular for the first flight - be selected on a basis which would allow the application in depth (down to the component and subsystem level, if possible) of more rigid procedures for quality control, testing, test history review, and final product acceptance.

In the area of spacecraft/Agena interface, JPL thought some improvement in the inherent reliability might be possible. It was suggested that with the elimination of sterilization as a requirement, LMSC should, while modifying the adapter to a lighter-weight configuration, also determine the reliability effects of relaxing certain interface sealing requirements on the shroud-ejection and spacecraft-separation systems. A review of the interface electrical-connector design was also deemed desirable.

JPL reiterated interest in the recently measured torsional-vibration environment generated by the Atlas upon booster engine shutdown, and its adverse effects on the Agena stage. It was pointed out by MSFC that LMSC was in the process of evaluating the Atlas data and its potential effect upon the Agena, but had reached no conclusions as yet.

b. A Ranger quarterly review meeting was held at JPL on February 19, 1963 with NASA Headquarters representation. That portion of the meeting concerning launch-vehicle plans showed that basic reorganization was still taking place. Specifically:

(1) A tentative LeRC organization for the Agena project was presented,

(2) The role of SSD was to remain unchanged until the Seamans-Schriever agreement had been signed,

(3) The Goddard Space Flight Center (GSFC) launch organization was to get a new charter since the relationship between LeRC and NTSO was not clear.

Discussions encompassed the role of technical panels, the NASA and JPL contractual relationships with LMSC and GDA, the role of LeRC field representatives, and a detailed review of launch-vehicle action items.

3. Interface Changes and Review

a. The "B" change to Specification No. 30947 was released on March 15, 1963, to reflect the current Ranger Block III requirements. In the absence of more definite information regarding the adapter diaphragm, it was to remain essentially as it was on the Block I and II missions. If a decision to remove the diaphragm were to be made, a further change would be required. The changes were all identified and listed in the front of the specification.

The "C" revision to the Ranger Block III Interface Specification was released on September 15, 1963. The revision was necessary primarily because of the decision to remove the heavy fiberglass diaphragm from the adapter. Other changes were made in the specification to reflect the current requirements of the Block III program.

b. At a quarterly review meeting at JPL on May 21, 1963, possible schedule slips were discussed at length. Design changes were decided upon, and notification was given that Block III launches would be made from Pad 12 only.

The last quarterly review prior to the launching of Ranger VI was held at JPL on August 13, 1963. Information concerning the launch-vehicle aspects of the forthcoming flight was presented by the Lewis Research Center. All of the required Atlas improvements were to be made for the flight, and the booster steering capability would be available if desired by JPL.

4. Launch-Vehicle Review

In a letter to the Agena Systems Manager, Lewis Research Center, dated March 11, 1963, the Ranger Project Manager outlined all the recommendations which had been developed by the Laboratory for improving the reliability of the Atlas/Agena, and which were believed to be essential to maximizing the probability of mission success for Ranger Block III launches. The assistance of members of the Laboratory's technical staff was offered to the Lewis Research Center.

The letter of March 11 to the Agena Systems Manager was followed by another letter dated March 26, 1963, from the Assistant Laboratory Director for Lunar and Planetary Projects, emphasizing the very great importance that the Laboratory attached to the implementation of the recommendations outlined in the March 11 letter. Concern was also expressed over possible personnel and procedure problems which might result from a too-rapid changeover in organizational responsbilities.

In a teletyped message transmitted on April 22, 1963, the Ranger Project Manager advised the Agena Systems Manager of his desire to conduct a comprehensive design review of the Atlas/Agena launch-vehicle system for the Ranger Project as soon as practicable, and to have JPL people who were experienced and knowledgeable in the launch-vehicle area present at the review.

The requested launch-vehicle system review for Ranger Block III missions was conducted by the Agena Systems Manager at the Lewis Research Center, Cleveland, Ohio, on June 3, 4, and 5, 1963, with the JPL review board in attendance. The board prepared and issued a report dated July 1, 1963 (Ref. 7), summarizing and assessing the Lewis plan of action as presented in the June design review. Included in this report were a number of technical and programmatic recommendations which the board felt would measurably improve the Lewis plan.

5. Launch-Vehicle Action Items

A system was developed in the Launch-Vehicle Section in October 1963 to expedite the solving of interface problems. As an administrative tool, an up-to-date list was maintained and issued periodically, showing the status of outstanding action items. Copies of this document were sent to NASA Headquarters, Lewis Research Center, and Lockheed.

This system proved to be very valuable in establishing the current status of any particular action item at any given time (Appendix K).

6. Ranger VI

Match-mate tests of the Ranger VI spacecraft with the flight adapter and nose fairing were held September 4 to 7, 1963, at JPL. An extensive list of action items resulted from these tests. It was noted that the clearance between the shroud liner and the solar-panel hinges was so critical that it was necessary to install recesses in the liner.

Ranger VI was launched on January 30, 1964, on the first countdown of the launch period. The launch countdown proceeded normally; however, several minor holds were called because of Atlas fuel-tanking operations and GE ground guidance problems. The performance of the Atlas 199D/Agena B 6008 launch-vehicle system was nominal through all flight phases leading to injection of the spacecraft on the lunar trajectory.

Nearly perfect booster-coast apogee conditions resulted from the Atlas performance. Booster-steering capability was available, but it was not necessary to use it. Atlas Agena separation was normal.

All Agena subsystems performed in a nearly nominal manner throughout the upper boost phase of flight. New items on board were the Hercules ullage rocket and a new type of power converter; both operated normally. Agena/spacecraft separation and Agena maneuver events were normal. Trajectory studies showed that the Agena vehicle passed the Moon on the trailing side, but within its effective gravitational field.

Flight of the spacecraft appeared normal until 10 min before impact on the Moon. At this time it became apparent that full TV power had not been switched on as it should have been, and no pictures were obtained from the mission.

After the Ranger VI flight, questions were raised regarding the possible effects of the launch-vehicle and the launch-to-injection environment upon the operation of the spacecraft. Investigations were started in April 1964 in the areas of electrical transients, accumulated high-electrostatic charges, mechanical and electrical operations of the umbilical plug and door, ionized gases, and blast waves at booster ejection. It was intended to determine, through these investigations, whether these environments could have affected the operation of the Ranger VI TV circuits, and whether the changes introduced on the Ranger VII spacecraft would preclude any deleterious effects because of the above mentioned phenomena.

Extensive analyses and tests of Ranger spacecraft susceptibility to high-voltage charge and discharge transients were performed to determine whether charging of the spacecraft and launch vehicle due to the rocket engines, or subsequent discharge of a charged vehicle to clouds or exhaust trail, could create a mechanism for spacecraft degradation or failure. Since the shroud around the spacecraft is not a perfect conducting surface, some field will exist inside it and will be available to induce voltage into spacecraft circuitry.

Tests were conducted on the Ranger spacecraft TCM to determine the magnitude of induced transients into typical spacecraft circuitry and to evaluate the possibility of these transients as failure-producing effects. Although the transients developed during the tests were not of sufficient magnitude to constitute a probable cause of catastrophic failure, the possibility did exist that these conditions could cause a temporary malfunction of a live spacecraft. As a result, the proof test model in the Ranger VII configuration was also subjected to this high-voltage environment. No temporary or permanent malfunction or failure occurred on the PTM during these tests.

Some spacecraft lines from the umbilical to subsystem circuits were shown to be sensitive to electrical transients during tests of the PTM in the Ranger VII electrical configuration, but no anomalies similar to the Ranger VI events were noted.

One recommendation resulting from the investigations thus far was that launch vehicles be instrumented to provide actual and accurate flight data in order to understand the flight environment better and to more specifically determine the electrostatic charging and discharging rates. Investigations of the suspected potential problem areas continued.

7. **Ranger VII**

Match-mate tests of the Ranger VII spacecraft with the flight adapter and shroud were performed at JPL October 15 to 17, 1963. A spacecraft dummy run was made on October 18 and 19, using the flight adapter and shroud.

The possibility of contamination due to the spacecraft pyrotechnic system was raised by LMSC. The Lockheed Receiving Inspection Group found contamination of some sort on the Agena adapter upon its return to Sunnyvale. Questions were immediately raised as to whether the spacecraft was contaminated also, whether pyrotechnics tests should be performed on flight equipment, and, basically, as to the nature of the contamination. All of these questions were finally resolved.

The first attempt at launching Ranger VII was delayed essentially because of a GE ground guidance problem. The second attempt on July 28, 1964, proceeded smoothly and resulted in the successful launching of the spacecraft.

The Atlas 250D/Agena 6009 launch-vehicle combination, together with the radio guidance system, placed the spacecraft on a coasting trajectory well within the injection requirements. All vehicle subsystems performed within tolerance.

Radio-guidance steering of the Atlas during the boost phase was effected for the first time on a NASA mission. Prior to the first steering signal the vehicle was traversing a 2.6σ lofted trajectory. Steering commands were sent for 3 sec during the booster-steering-enabled period of 100 to 110 sec to turn the vehicle a total of 1.68 deg down, and back on course. At sustainer-engine shutdown, the Atlas contained enough propellants for 4.8-sec additional operation at rated thrust.

The Agena performed satisfactorily throughout both coasting and thrusting phases, delivering the spacecraft to the injection point with 35 ft/sec excess velocity. This, however, is within the capability of the spacecraft midcourse system to correct the trajectory to that desired. At injection the Agena contained enough propellants for 2.3-sec additional operation at rated thrust.

The Ranger VII flight was the first completely successful Ranger mission. Outstanding mission accomplishments were the text-book operation of the launch-vehicle system, the precision of the midcourse maneuver, and the transmission of 4316 video pictures of the lunar surface.

8. Ranger VIII

Match-mate tests of the Ranger VIII spacecraft and the LMSC flight adapter and nose fairing were held from February 11 to 14, 1964. Special inspection procedures were carried out to ensure that there would be no contamination of the adapter due to the firing of squibs in the JPL dummy run.

Preliminary data showed that the combined-spring-rate constants using adapter 6006 were not compatible with results of other match-mate tests. JPL, suspecting a crack either in a spacecraft leg or in the adapter, carried out further tests on the spacecraft. After verifying its integrity, JPL requested that the spring-rate portion of the tests be performed again. This was done at JPL during April 20 to 22. Discrepancies were found in the fabrication of the adapter.

When it became apparent after the flight of Ranger VII that the launch schedule would be delayed, JPL requested that match-mate tests be performed again on Ranger VIII. These tests were accomplished from October 29 to November 5, 1964. Minor difficulties were found in the RF cabling losses and in the Agena umbilical door-closing operation.

Launch-countdown operations for Ranger VIII were exceptionally smooth. At T minus 100 min, a 10-min hold was called to remove a signal flag which had been left inadvertently on the Atlas. There were no holds charged to the Ranger Spacecraft.

The Ranger VIII/Atlas 196D/Agena B6006 space-system vehicle was launched, as scheduled, on the first day of the launch period. Liftoff occurred on February 17, 1965, less than one second into the window.

All Atlas 196D discretes were close to nominal. The residual propellants corresponded to a 4.97-sec burning period. Downward booster steering was employed during the flight. The indicated booster lofting was 1.6 σ. The GE guidance canisters were soft-mounted on this vehicle for the first time.

Heat-protective paint was applied to certain regions of the booster skin to reduce temperature; the effects of the paint were noted and tabulated. At booster engine cutoff, BECO, a shock of 60 g peak-to-peak was seen by the rate beacon. Two telemetry measurements were lost in the flight.

No major anomalies were observed in the Agena for the Ranger VIII flight. A refurbished engine had been incorporated in the final flight configuration after its long delay in storage; additional fuel was found to be necessary from the results of a series of tests and a study of the engine's performance. There was evidence that a failure occurred in the helium pressure regulator at T + 60 sec. Helium leaked through the regulator and was dumped through the oxidizer spill valve. This was believed to be a random failure, but the possibility that it was caused by vibration, occurring after the transonic period was to be investigated.

Several minor anomalies were recorded for the flight. The umbilical door closure on the Agena adapter was monitored by motion pictures at liftoff. The door appeared to bounce before it finally closed and latched. Two temperature measurements were lost at launch. The fuel-tank pressure transducer read low, apparently because its vent port was plugged. It was suggested that an inspection label remained over the port. Data from the transducers were usable.

The mission of Ranger VIII was completely satisfactory in all respects.

9. Ranger IX

Match-mate and spacecraft tests utilizing the flight adapter and shroud for Ranger IX were performed at JPL from December 21, 1964, to January 4, 1965. The test sequence for measuring the clearances between the shroud liner and the hinge points on the solar panels had to be performed twice. Since the spare set of solar panels was machined differently at the hinge points, the flight panels and the spare panels required separate tests (with the panels mounted on the spacecraft).

Launch operations were normal and continued smoothly. Minor holds were called because of Agena velocity-meter checks and because of incomplete blockhouse tests.

The Ranger IX/Atlas 204D/Agena B6007 space-system vehicle was launched as scheduled on the third day of the launch period. It had been decided that there would be no attempt to launch on the first two days of the launch period because of relatively poor lighting conditions at the most desirable target point on the Moon. Liftoff was on March 21, 1965, 26 min after opening of the window.

The Atlas 204D flight was nominal. Residual propellants represented 6.0 sec of remaining burning time. The Atlas trajectory was lofted 2.4 σ at 100 sec, and booster steering occurred at 100.2 sec. A shock observed at T + 112 sec seemed to be the only unexplained anomaly.

A suspected prevalve closing that occurred on a Surveyor/Atlas about two weeks earlier led to the use of a small wedge in locking all Atlas prevalves, including Atlas 204D, open. No trouble was experienced in this area during the Ranger IX flight.

All primary and secondary Agena objectives were met on the Ranger IX flight, and Agena performance was satisfactory in nearly all respects. A refurbished engine was used (as on the Agena B6006) to retain high flight reliability in spite of long storage.

Several minor anomalies occurred during the launch phase. It was definitely determined that the spacecraft/adapter umbilical door did not latch in the closed position during flight. PL 33, a tangential accelerometer, and PL 34, an axial accelerometer, exhibited erratic behavior during the Atlas-powered flight (T+40 to T+60 sec). PL 35, another tangential accelerometer became erratic during the Agena burns, but useful data were obtained. The need for a better low-frequency accelerometer system for future flights became apparent.

D. BLOCKS IV AND V

1. Plans for Additional Missions

Plans had been made for continuing the Ranger Project by implementing the Block IV and Block V missions as approved by NASA. These plans had been made continuously without jeopardizing the Block III missions. Guidelines and schedules were kept up to date and were distributed to cognizant personnel at all levels.

2. Cancellations of the Missions

Ranger Block IV, planned as a series of three flights, and Ranger Block V, planned as a six-flight series, were cancelled due to budget reasons by NASA's Office of Space Sciences in July and December, 1963, respectively.

SECTION II. INTEGRATION REQUIREMENTS

A. DESCRIPTION OF REQUIREMENTS

From the standpoint of launch-vehicle/spacecraft integration, the manner of establishing mission requirements and the method of accomplishing compliance with these requirements appeared to be fairly straightforward problems. It was clear from the beginning that there could be only one source for the emanation of mission requirements; therefore a unilateral document defining these requirements was issued. Split authority or joint responsibility would not have been consonant with the "Project" concept; i.e., of operating under one director.

1. Document Format

It was found that the format of Military Specifications (MIL-SPECS) very closely fitted the outline of requirements and restraints which was required by the Launch-Vehicle Integration Section. It should be pointed out that at the time of definition of these particular requirements and restraints, a specific booster system had been chosen for the mission and that each area of integration effort might (and probably would) overlap certain other areas of effort because of the complex interrelationship of all phases within the project.

Within the interface document, it was found to be mandatory (in order to expedite the exchange of information) to provide a general description of the launch vehicle and its capabilities, the mission trajectory with altitude requirements, and the mission end objectives which the spacecraft was expected to satisfy. The document defined all known areas of integration requirements and of possible areas of interference. It included intangibles (software) such as atmospheric and environmental relationships, as well as tangibles (hardware) including mounting techniques and cable-connector locations.

2. Definition of Systems

The relative positions of the launch vehicle, spacecraft, nose fairing, and adapters in an assembled configuration were provided to show the interface areas and the relationship of reference systems (Fig. 18). Definition was made of a sequence of flight events showing all the programmed items which were reflected through the interface. All operations of spacecraft mechanisms or electrical circuits that could interfere with the launch vehicle, and all launch vehicle operations that could interfere with the spacecraft were identified.

The requirements for obtaining tracking coverage and for establishing RF links were specified. Tracking of the launch vehicle for spacecraft purposes, and establishing command communication with the spacecraft while it was enclosed within the shroud required the integration of cabling, switching, and antenna designs. Requirements for the reduction and dissemination of data were also outlined.

3. Mechanical Interface

The spacecraft properties of mass, including the weight, center of gravity, moments of inertia, and products of inertia were specified within given tolerances. Other information on the interface area, such as spacecraft bending, shear, and stiffness factors, was made available separately in more detailed documents.

An arrangement drawing of the spacecraft, adapter, and nose fairing, showing the locations of interface connectors, ducts, umbilicals, and antennas was provided. Sealing and RF transmitting requirements were indicated, and static and dynamic clearance requirements were specified by showing their limiting envelopes. Production tolerances, flight vibration, bending, and maximum variations in the separations systems were taken into account in establishing maximum limits.

Separation requirements and restraints were specified for nose-fairing ejection and for spacecraft separation. These included attitude-turning rates, clearing rates, and distance-time relationships.

4. Electrical Interface

The electrical requirements in the interface area included a listing of the spacecraft instrumentation, and of the launch-vehicle instrumentation within the spacecraft compartment which was to be telemetered over the launch-vehicle RF system during the boost phase of flight. A chart was prepared (Table III) specifying the measurement range and data response of each instrument. Electrical circuits were transformer-isolated (Fig. 19).

Requirements for redundancy were specified for all circuits that activated mechanisms for nose-fairing ejection and for spacecraft separation. Restrictions were placed upon the type of electrical disconnects allowable and upon the methods of making RF connections.

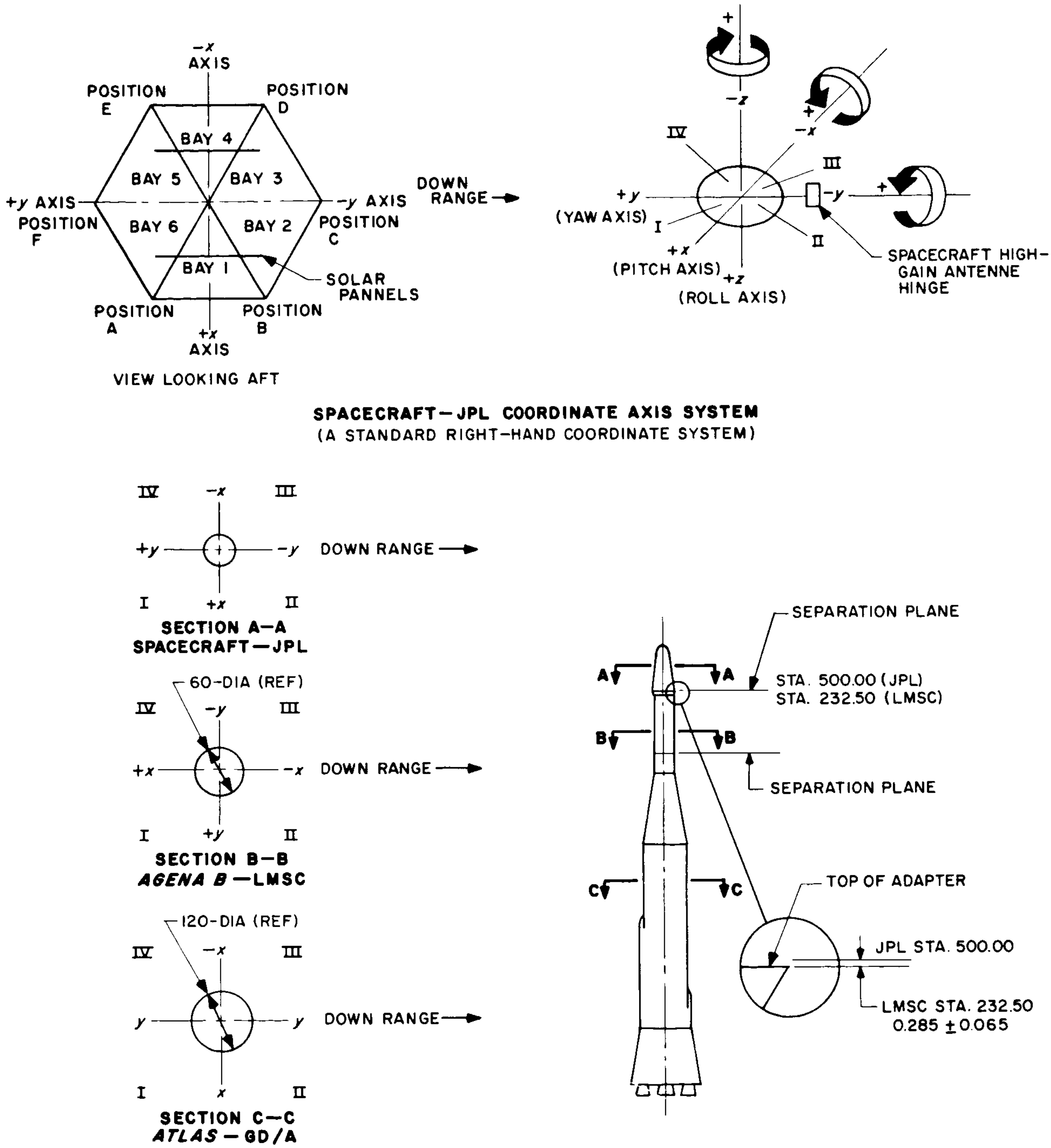


Figure 18. Coordinate Axis System
Ranger/Agena/Atlas

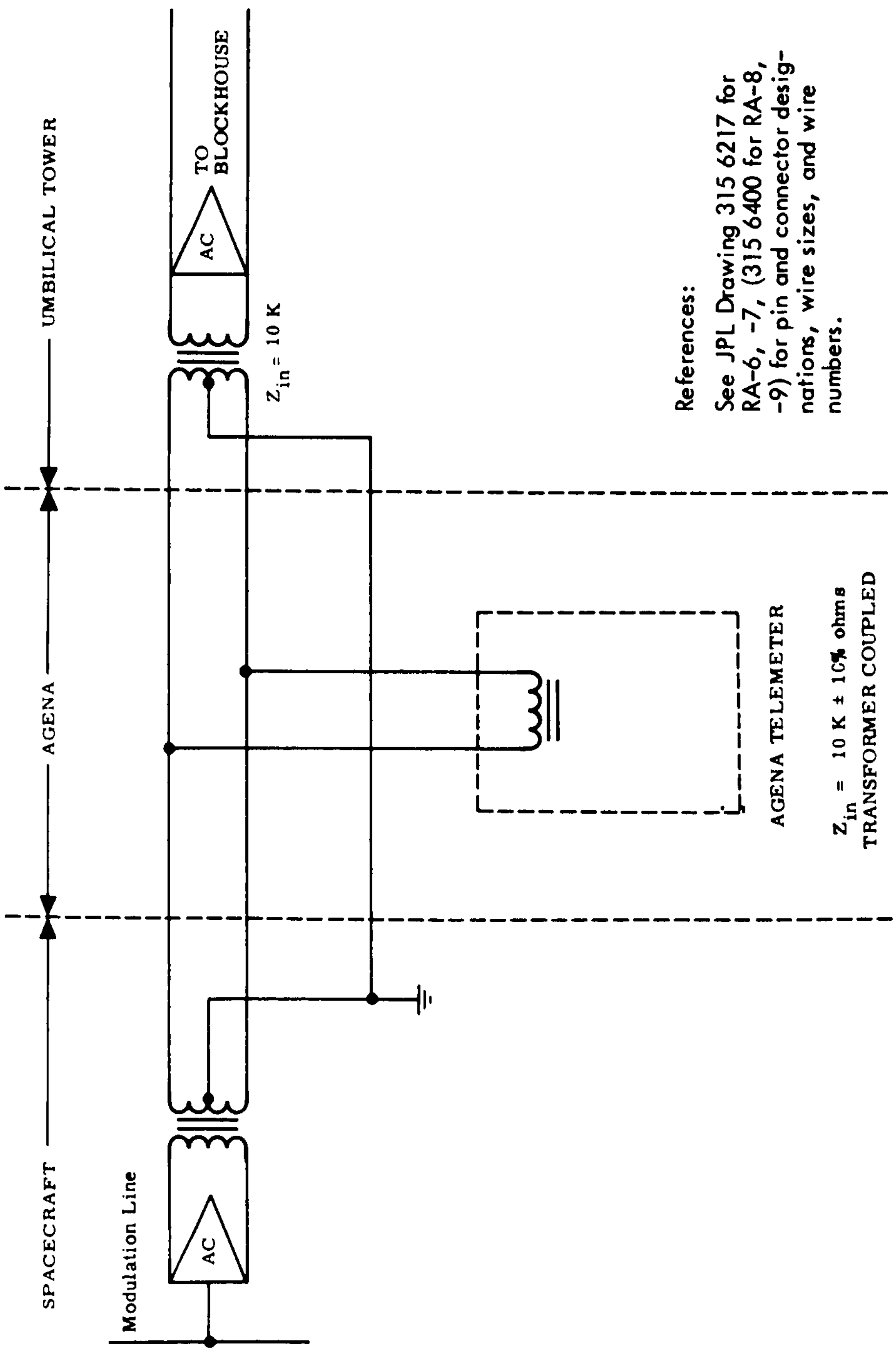


Figure 19. Interface Diagram

Table III. Shroud and Adapter Environmental Monitoring

Two (2) shroud temperature and five (5) adapter vibration measurements are required.

Location and Orientation	Measurement Range	Data Response	Measurement Accuracy	Time of Flight Data Needed	Purpose of Measurement	*Relative Polarity
Temperature:						
1. Inside shroud, near nose	32° to 1500°F	Sampling at 5 samples/second is adequate	±5 percent or better	From ATLAS launch to shroud separation	To determine spacecraft temperature environment during ascent	"B"
2. Inside shroud, near base	32° to 1000°F	Sampling at 5 samples/second is adequate	±5 percent or better	From ATLAS launch to shroud separation	To determine spacecraft temperature environment during ascent	"B"
Vibration:						
3. RA-6 Radial, RA-7 Axial, RA-8 Radial, RA-9 Axial } As close to spacecraft as possible at shear and tension attachment point "A"	±10 g peak ±25g PEAK FOR RA-9	20 cps to 2 kc (LMSC Ch. 17)**	±10 percent	Priority "B" 1. From ATLAS launch to T +20 sec. 2. Time periods of at least 10 sec. before to 10 sec. after the following events: Max "Q" BECO, AGENA 1st burn shutdown, AGENA 2nd burn ignition. 3. Time period of at least 10 sec. before SECO to at least 10 sec. after AGENA 1st burn ignition. 4. Time period of at least 10 sec. before AGENA 2nd burn shutdown to at least 10 sec. after spacecraft injection. Note: Measurements 5, 6 and 7 shall be switched to mechanical separation transducers (Ref. para. 3.7.5) at approximately 10 sec. after AGENA 2nd burn shutdown. OR Priority "C" Entire flight from ATLAS launch to 10 sec. after spacecraft separation.	(1) To determine the launching environment (2) To provide spacecraft structural design verification	"B" or "C" as in "Time of Flight Data Needed"
4. Noise Microphone	115 to 145 db relative to 0.0002 microbar	20 cps to 2 kc (LMSC Ch. 18)**	±10 percent		(1) (Same as above) (2) (Same as above) (3) To look for a torsional mode (the phase relationship of one channel to another must be known)	As in 3 - "Time of Flight Data Needed"
5. (a) Radial, at point "A" for RA-6, 7 and 9	±1.5 g peak	0 to 150 cps nominal (LMSC Ch. 10)**	±10 percent			
(b) Tangential at point "B" for RA-8	±5.0 g	0 to 150 cps nominal (LMSC Ch. 10)**				
6. Tangential, shear tie attachment point "D" opposite measurement 3	±5.0 g peak	0 to 150 cps nominal (LMSC Ch. 11)**	±10 percent			
7. Tangential, same attachment point as measurement 3	±5.0 g peak	0 to 150 cps nominal (LMSC Ch. 12)**	±10 percent			
8. Axial for RA-6, 7, 8 and 9 in spacecraft adapter	+8.0 g -3.0 g	0 to 150 cps nominal (LMSC Ch. 9)**	±10 percent			
9. At least one vibration measurement is required to be placed in a spacecraft electronic case for RA-8 and RA-9.	±10 g peak	20 cps to 2 kc nominal	±10 percent			

*Relative priority is coded as follows:
- "A" - Required measurement without which we could not fly.
- "B" - Necessary measurement to assist in evaluating spacecraft performance.
- "C" - Desirable measurement to assist in evaluating spacecraft performance.

**For Information Only

Note 1: Measurements 1 through 7 shall be continued on all #1 flights unless more urgent needs, approved by JPL, LERC, and LMSC, develop.

Note 2: The environmental transducers (measurements 3, 4, 5, 6, 7 and Para. 3.7.5) shall be calibrated with respect to amplitude and phase (Measurements 6 and 7 tangential accelerometers require phase calibration with respect to each other). The information should be supplied in accordance with Table IV.

Electrical interfaces on the launch complex were detailed in separate JPL specifications (Fig. 20).

5. Environmental Restraints

Thermal limitations were placed upon the spacecraft environment to safeguard proper operation of components, and to prevent the excessive outgassing of materials with resulting contamination under the combined effects of high temperature and vacuum. LMSC was made responsible for all the necessary ground-cooling facilities as well as for in-flight protection against excessively high temperatures.

Restrictions were placed upon the selection of materials to be used in the interface areas. Since the performance of instruments, cameras, temperature-control surfaces, and solar panels would be degraded if excessive outgassing and smoking occurred, the permitted concentration of particle size was generally specified. This was done either by identifying an acceptable filter and flow rate, or by specifying the allowable concentration of particles within a given range of micron sizes.

Radio-frequency interference (RFI) requirements were specified in the required test procedures. Generally, the objectives of these tests were to:

a. Determine sub-system susceptibilities, and

b. Determine system capabilities with all subsystems operating simultaneously.

Operation of the equipment was tested, with the equipment subjected to radiated or conducted transients, cross-modulation, or inter-modulation. The complete identification of all radiating equipment in the system was necessary. Identification was to include frequency bands and voltage (power) levels.

Miscellaneous environmental requirements were specified in regard to permissible accelerations (applied loads), acoustical noise, vibration levels at specified frequencies, and shock.

Since realistic values were unknown for many of the environments, there were requirements in the document for instrumenting the launch vehicle with a view toward compiling comprehensive data for future flights.

6. Test Requirements

Test requirements included specific "type-approval" verification tests and final match-mate tests of all flight equipment involved in the interface area. Verification tests

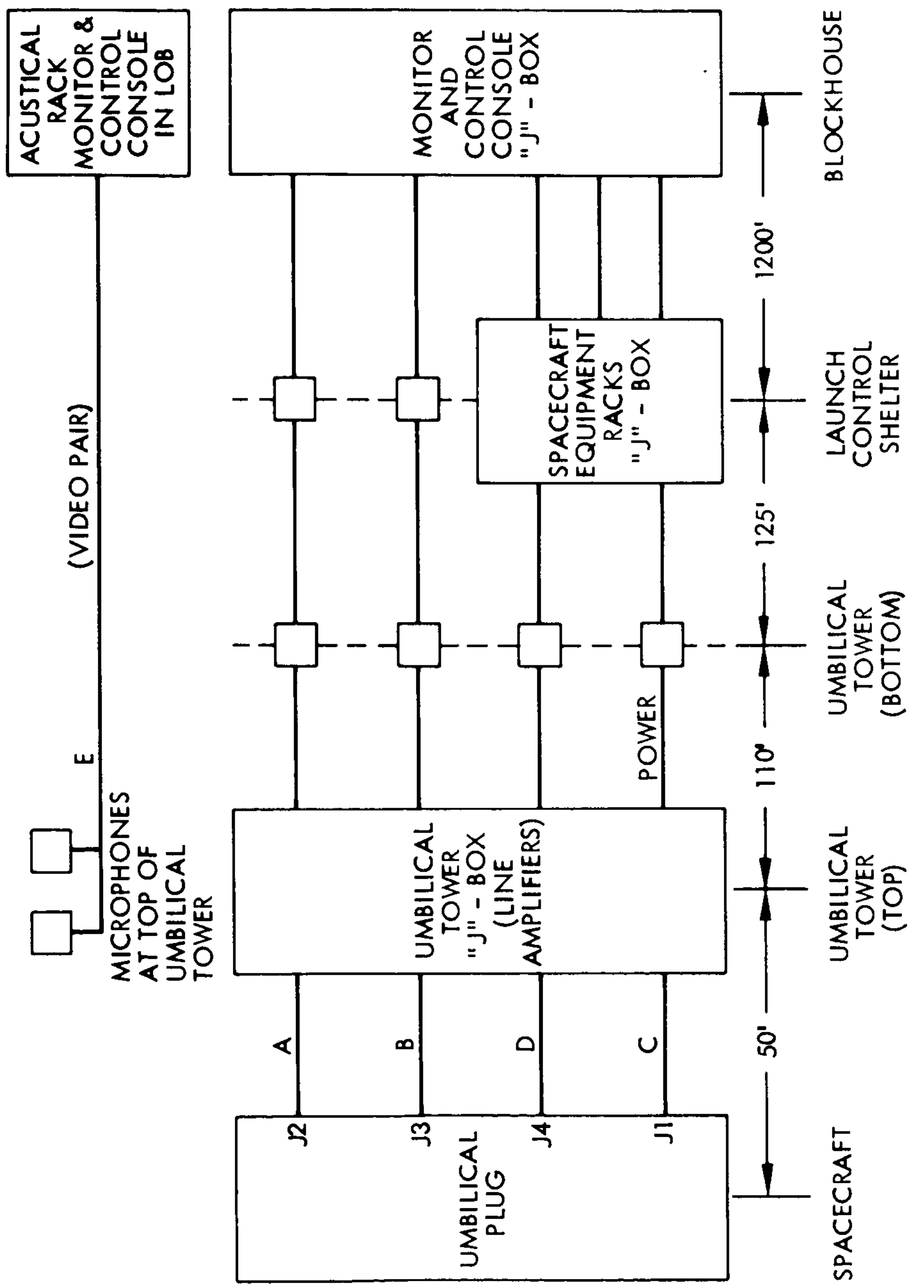


Figure 20. Launch Complex Cable Routing

included static and dynamic tests to ensure the structural integrity of all components, and separation tests to verify clearances and proper performance. Match-mate tests included a "ring-out" of cabling, mechanical mating of the spacecraft/adapter and nose fairing to the Agena forward equipment rack, and RF checks through each of the antenna couplers.

7. Supporting Requirements

It was requested in the "Notes" section of the document that adequate programs be installed at each facility to ensure a completely unencumbered exchange of information and to provide an immediate response as soon as a need was expressed. Mandatory exchanges of reports and information were specified in some cases. These included periodic weight reports, test plans and results, and the minutes of meetings.

B. JPL INTERFACE DOCUMENTS

The launch-vehicle integration requirements for Ranger were published throughout the program in the form of JPL specifications. The first document, JPL Specification 30331 was classified; it was published initially on May 4, 1960. With the various changes and revisions that were made necessary from time to time, it served its purposes for Blocks I and II. By authority of EPD 20, dated January 2, 1961, Specification No. 30331 with changes A, B, and C, and Pre-release Change D were downgraded to "Unclassified" May 24, 1965 (Table IV).

The document used for accomplishing Block III launch-vehicle integration was JPL Specification 30947. The classified portion of 30331 was removed from the text, and with the requirements and restraints brought up to date, it was found that the document had more extensive use and provided more timely information in the unclassified form. Changes in requirements occurred from time to time and were published as deemed necessary.

Engineering Document A-161 (EDA-161) presented the launch-vehicle integration requirements for Block IV in a new format. The change from the format of specifications was made in order to include requirements or limitations of the launch-vehicle system as well as those of the spacecraft, and to include requests and recommendations of a general and "joint interest" nature. Since the Block IV portion of the Ranger program was cancelled,

Table IV. Launch Vehicle/Spacecraft Interface Requirements

Document	Release Date
Blocks I and II:	
JPL Specification 30331 (classified Confidential)	4 May 1960
A Change	6 June 1960
B Change	18 January 1961
C Change	5 August 1961
D Change (Pre-release)	21 December 1961
Block III:	
JPL Specification 30947	30 January 1962
A Change	26 October 1962
B Change	15 March 1963
C Change	15 September 1963
D Change	14 July 1965
Block IV:	
JPL Engineering Document A (EDA-161)	10 June 1963
Block V:	
JPL Engineering Planning Document (REO-182 EPD)	2 October 1963

this document was never published formally.

Engineering Planning Document 182 (EPD-182) contained, for purposes of launch-vehicle integration, the mission requirements which were imposed upon the launch vehicle, upon the aerospace ground equipment, and upon the supporting facilities by the Ranger Block V program. The necessary tests and test equipment which were deemed to be necessary to ensure compliance with the requirements were also presented.

The essential purpose of the EPD was to coordinate the efforts of Northrop Space Laboratories (NSL), as the spacecraft fabricator, with the launch-vehicle contractor through JPL and the Lewis Research Center. Significant changes appeared in the requirements for exchange of information, inspections, and methods of conducting engineering liaison. The document was never actually released, due to the cancellation of Block V in the Ranger program.

C. LAUNCH PAD

1. Basic Requirements

The primary requirements for the design of the Ranger Ground Support Equipment (GSE) installation at Launch Complex 12 were presented in JPL Specification No. 30533, dated June 24, 1960 (Table V). This specification covered the design criteria for the physical facilities needed, as well as the mechanical and electrical requirements for the support equipment to be used prior to launch. Communications had to be established with the spacecraft on the launch pad to perform loop checks and to make sure that spacecraft circuitry and mechanisms were in the proper firing mode.

The cabling, J-Boxes, adapters, and miscellaneous equipment required in the umbilical tower, launch pad, and blockhouse areas were specified as were the methods of emplacing and inspecting equipment in the completed installation.

2. Changes in Design

Several design changes were scheduled for the spacecraft or "payload" portion of AFETR complex 12 cable installation to meet the requirements of both the Mariner Mars Program and the remainder of the Ranger Program (Rangers VIII and IX). In addition to the equipment design changes, a functionally identical installation was planned for Complex 13

Table V. Launch Pad Interface Requirements

Mission	Specification	Date
RA 1 & 2	JPL Specification No. 30533	24 June 1960
	"A" Revision	2 August 1960
	"B" Revision	24 January 1961
RA 3, 4, & 5	JPL Specification No. 30564	21 April 1961
Ranger Block III	JPL Specification RCG-30583-DSN	8 March 1962
	"A" Revision	18 December 1963
	"B" Revision	15 July 1965
General	JPL Specification No. 30768	3 June 1963

primarily to establish a dual countdown capability. Because of the tight schedules between programs, maximum consideration was also given to design compatibility between the Ranger and Mariner Projects. Basic differences between Complex 12 and 13 were resolved in the JPL system-hardware design while maintaining the direct interchangeability feature of "like" JPL-supplied equipment for each complex.

Since the basic philosophy governing spacecraft launch-complex-system design applied to all current programs, and since much of the electronic-control equipment was identical, a general design specification was released (JPL Specification No. 30768) establishing the minimum requirements for electrical systems on current programs. This specification served as both a reference and a basis for the more detailed specifications which were issued for each program, and it detailed the basic philosophies governing system design for operational support equipment.

a. Boom cables. With the activation of Pad 13 for spacecraft use, consideration was given to improving the design of the cable link between the spacecraft and the first JPL equipment interface (the umbilical-tower junction box). Design improvements were made and were incorporated on both Pads 12 and 13 for the use of Mariner Mars and Rangers VIII and IX.

Although the total cable length between the spacecraft and the umbilical-tower J-box was increased from 50 ft to approximately 87 ft by the new routing of these cables, several advantages were realized and many undesirable features were eliminated by a change in individual cable design. The original Pad 12 installation required the use of a special cable retractor which pulled the 50 ft catenary (boom) cables clear from the retracting boom during launch. The advantages gained were obtaining a minimum cable length (50 ft), and an installation using the least number of interfaces. The new installation used 75 ft cables permanently routed down the boom (although still replaceable). The added length and the extra boom plate interface were compensated for by designing the cables with adequate low-resistance lines for external power and charging functions (no splices), and by including special low-capacity wiring for critical functions. The remaining link to the spacecraft consisted of a catenary cable (or cables) approximately 12 ft long, incorporating all special program requirements between the spacecraft and the boom plate.

The requirement for low-capacity lines was coupled with a requirement for temperature stability. This was true because most critical AC-type signals were affected not only by the total capacity of the line, but also by changes in capacity resulting from changes in temperature. Several types of low-capacity wire were found to be acceptable, and one type was incorporated into the design of two of the boom cables. Only a portion of the conductors in each cable was special however, since the complete use of this type of line would reduce the physical ruggedness of the cable.

b. Video pairs. The requirement for extensive signal conditioning and amplification of spacecraft signals, and the formerly severe environmental penalties imposed by the umbilical-tower location of the JPL umbilical-tower junction box resulted in a requirement for extensive expansion of the video pair installation at each complex. Six video pair lines were installed between the umbilical tower (JPL J-box area) and the L/P OSE area (launch-control shelter/LPB on Pad 12 and first-stage vehicle room/LPB on Pad 13). Also, six lines were installed between the L/P OSE area and the transfer room on each pad where connection was made to the existing pothead terminations of the permanently installed and existing video pair lines routed throughout the complexes.

c. Remote-control power. In addition to the remote control of JPL supplied 400-cps generators (as formerly provided for the MR program on Pad 12), an additional remote-control capability for 60-cps power, used to support the JPL equipment located on the umbilical tower and in the L/P OSE, was provided. The control panels for these circuits were located in each blockhouse.

D. TASK ORDERS

Initially, in order to accomplish spacecraft/launch-vehicle integration, JPL established administrative channels with the Marshall Space Flight Center who were to provide technical direction to Lockheed for the Agena and to General Dynamics/Convair for the Atlas.

The initial Lockheed effort, which was funded through FY '60, covered only preliminary engineering effort and the procurement of long lead-time items. Because the contractual scope of work at that time did not include all areas of interface engineering, this Laboratory was advised to specify required interface efforts as separately defined tasks.

To coordinate JPL interface requirements, MSFC "Task Assignment Directive" (TAD) forms were prepared and transmitted to the MSFC technical representative at BMD-BMS, with a copy to the NASA Plant Representative at LMSD, Sunnyvale. Generally the Task Assignment Directive contained short, concise statements of required interface action. Because the same TAD forms were employed by MSFC for both GSFC and JPL, an internal JPL identification system was used; namely, a TR numbering system, which was a JPL-conceived task system for interim usage until instructions were issued by MSFC. Where possible, JPL also provided an estimate of the man-hours required.

All TAD's were acknowledged within five days, either by rejection of the request effort, or by an indication that the Contractor had been instructed to proceed; then appropriate internal JPL distribution of the acknowledgment was made. No effort could be expended on TAD requirements, however, until contractual implementation had been effected.

The use of the TAD system did not preclude the informal interchange of engineering data between LMSD, MSFC, and JPL; however, it was necessary to keep in mind at all times that the Launch-Vehicle Integration Section had the JPL responsibility for engineering-design integration. Accordingly, engineers involved with interface problems worked closely with this Section to ensure a unified JPL approach. Continual judgment had to be exercised by JPL to make sure that a technical information request did not involve effort by a Contractor to generate new information, thereby incurring additional costs. If certain study efforts were indicated, however, specific TADs were prepared by JPL after an informal agreement had been obtained with cognizant Agencies.

Upon completion of the TAD's, the Contractor was notified promptly and officially whether or not the final reports were adjudged to be acceptable. In order to complete a TAD officially (after the TAD originator had completed his review of the report) a statement of acceptability or of non-acceptability was forwarded to the NASA Agena B Division, Headquarters, Air Force Ballistic Missile Division, Los Angeles, California (Ref. 8).

Table VI. TAD Status Report

TAD No.	Task Title	Originator	To LMSD	Completion
1.	Agena not to impact on the Moon	JPL	4-19-60	9-13-60
2.	Shroud not to collide with spacecraft	JPL	4-19-60	8-12-60
3.	Agena will not strike spacecraft after injection	JPL	4-19-60	7-11-60
4.	Trajectory calculations and performance studies, Lunar	JPL	4-19-60	7-12-60
5.	Error sources contributing to error of injection point	JPL	4-20-60	9-13-60
6.	Determination of Thor/Agena Payload Capabilities	GSFC	4-21-60	10-5-60
7.	RF transmission to and from JPL omniantenna	JPL	5-9-60	6-22-60
8.	JPL request for telemetry data	JPL	5-9-60	6-22-60
9.	Preinjection trajectories	JPL	5-24-60	9-6-60
10.	Radar tracking system	JPL	5-24-60	6-3-60
11.	Shroud/Spacecraft thermal relationship	JPL	6-17-60	8-10-60
12.	Preliminary trajectory for S26/S27	GSFC	7-6-60	- - -
13.	Satellite mission error analysis	GSFC	7-6-60	2-14-61
14.	Nimbus injection error and launch delay study	GSFC	7-6-60	1-20-61
15.	Trajectory for Thor NIMBUS-POGO	GSFC	7-20-60	7-20-60
16.	Access equipment at PMR	MSFC	8-8-60	9-20-60
17.	Trajectory study, POGO	GSFC	(TAD not reqd)	12-27-60
18.	Documentation of methods and procedures for trajectory calculations	MSFC	11-2-60	
19.	Propellant requirements	MSFC	11-15-60	
20.	Trajectory optimization study for POGO	GSFC	12-16-60	
21.	Trajectory optimization study for EGO	GSFC	12-16-60	
22.	Trajectory optimization study for NIMBUS	GSFC	11-21-60	
22.	Amendment		3-22-61	
23.	Trajectory optimization study for S-27	GSFC	11-21-60	
24.	On-orbit lifetime study for POGO	GSFC	12-30-60	4-14-61
25.	Demating of Agena during launch operations	MSFC	2-7-61	
26.	Dynamic analysis OAO spacecraft	GSFC	2-13-61	4-25-61
26.	Amendment		3-29-61	
27.	Study shroud configuration - OAO spacecraft	GSFC	2-13-61	
27.	Amendment		3-31-61	
28.	Omniantenna configuration study for RA-3	JPL	2-14-61	
29.	Payload weight status POGO, EGO, OAO, OSO	GSFC	3-17-61	
30.	Nimbus 15° cone study	MSFC	4-11-61	(Cancelled)
31.	Dynamic analysis Thor/Agena B/OGO	MSFC	4-11-61	
32.	OGO adapter and separation system design studies	MSFC	6-22-61	(Cancelled)

SECTION III. TESTS

A. COMPATIBILITY TESTS

1. Static

Two separate series of static tests were performed in accomplishing launch-vehicle/spacecraft integration in the Ranger Program. The first series was performed in the early design stages prior to the flight of Ranger I; the second occurred after the flight of Ranger V as part of an extensive review of the overall system.

a. Early tests. Static tests were held at CALAC in Burbank from April 4 to May 19, 1961 (Ref. 10). Both the JPL spacecraft and the Lockheed assembly were instrumented (Fig. 21).

The primary objectives, from the viewpoint of the spacecraft side of the interface, were to:

(1) Determine the stresses in the Ranger spacecraft bus if the bus were to fail before the Agena adapter;
(2) Determine the failure load of the spacecraft bus if the bus were to fail before the Agena adapter or the nose fairing;
(3) Determine the spring constant of the Lockheed adapter; and
(4) Determine the loads in the bottom hex tubes at JPL Station 500.00.

From the launch vehicle adapter side of the interface, primary objectives were to:

(1) Determine the load capabilities of the nose fairing under external pressure;
(2) Determine the structural soundness of an assembly consisting of a nose fairing, forward midbody, forward equipment rack, spacecraft support structures, and a simulated tank "Y" ring.

Test plans called for external pressures to be applied to the nose fairing in 0.25-psi increments from 0 to 4.63 psi and from 0 to 2.50 psi as shown in Fig. 22. Strain gage data were to be recorded after each pressure change (Ref. 12).

Loading on the entire assembly was to be applied simultaneously (Fig. 23) in increments at room temperature until 100% of the limit loads was reached. At this point the loads would be reduced to zero, an inspection conducted, and the loads

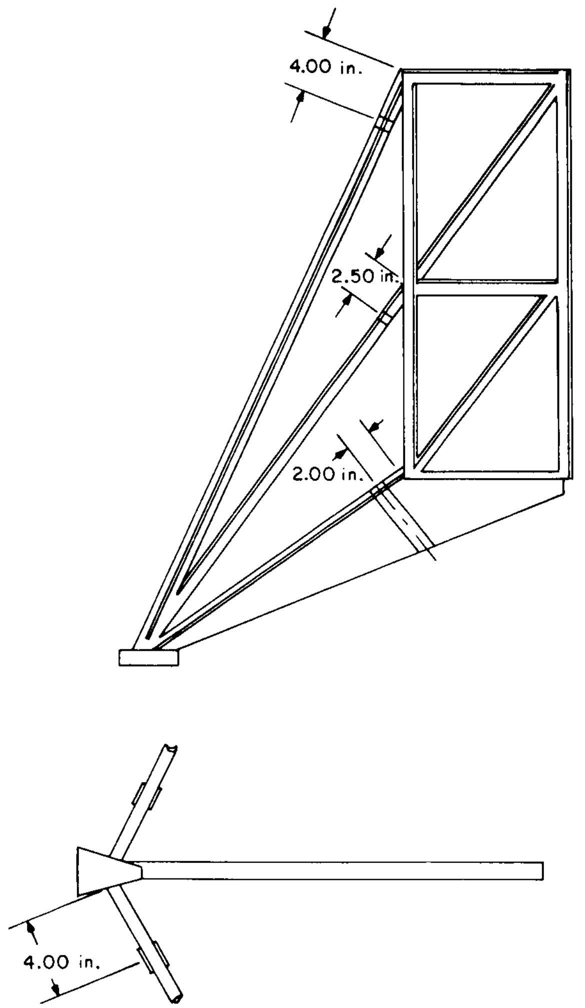


Figure 21. Location of JPL Strain Gages

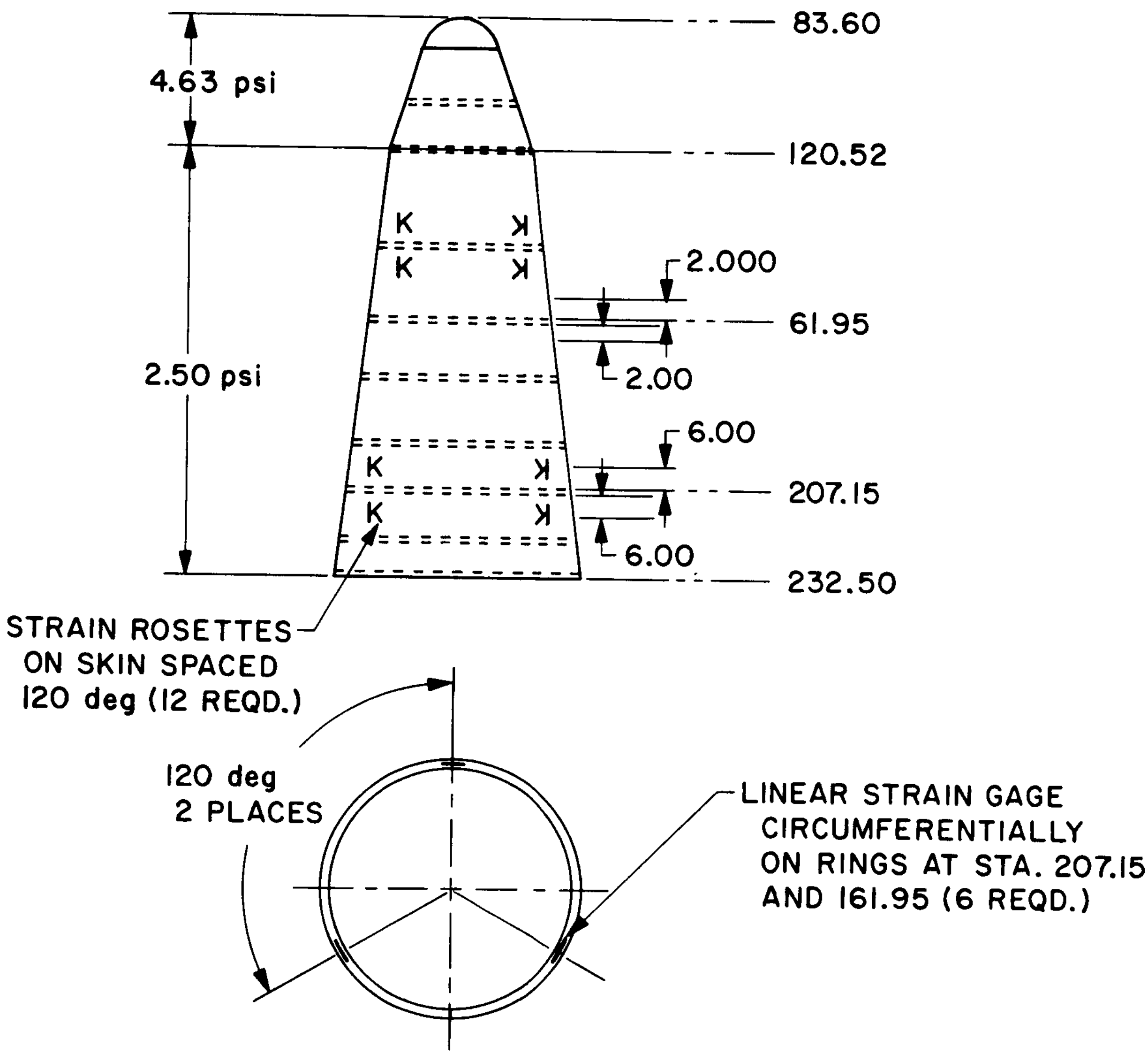
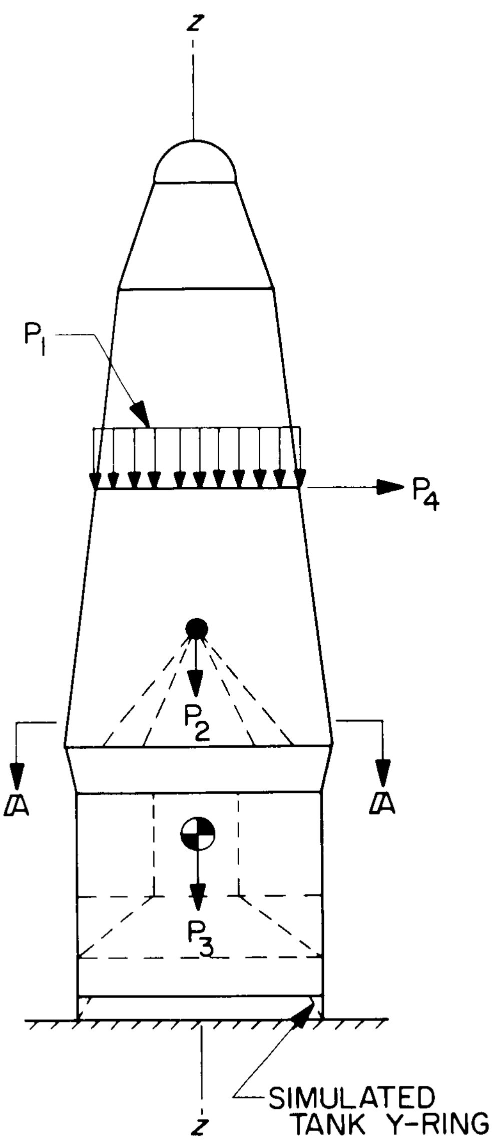
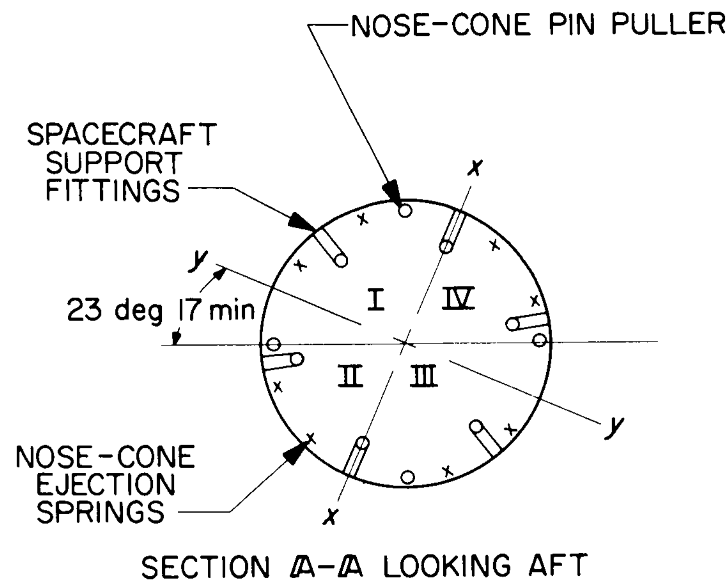


Figure 22. Nose Fairing Pressure Tests





CRITICAL FLIGHT-CONDITION LOADS	
P_1	6000 lb
P_2	2000 lb
P_3	2500 lb
P_4	4760 lb

Figure 23. Test Loads under Critical Flight Conditions

applied again until 125% of the limit loads was reached. The tests would be repeated until failure occurred.

A similar method would be employed in testing booster burnout conditions with the temperatures and loads applied at two different rates (Ref. 13). The temperatures, the direction, and the magnitude of these loads are shown in Fig. 24.

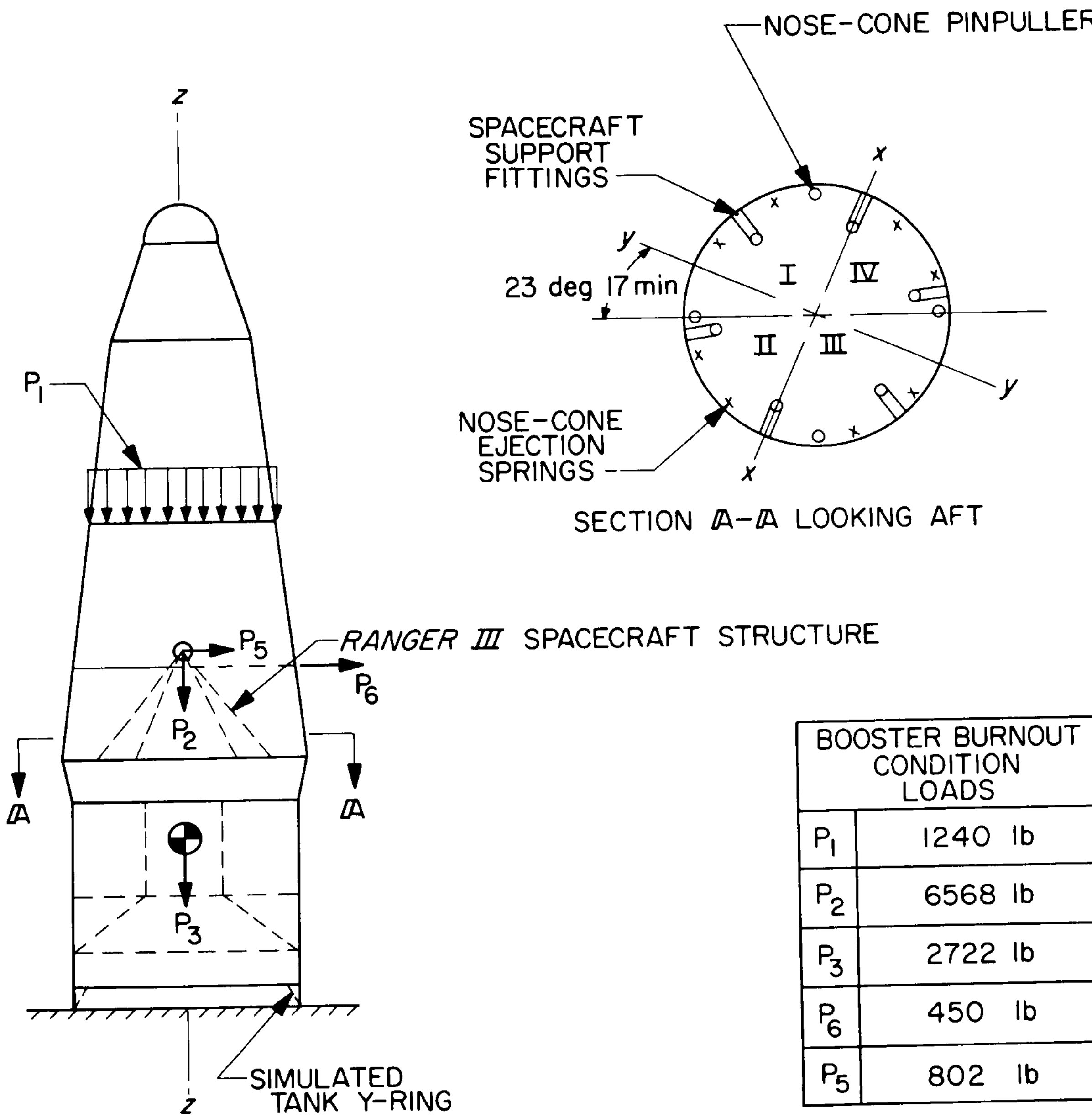
Radial thermal deflections were to be measured after the nose fairing was heated to 610° F at Station 226.50 and the adapter to 295° F at Station 238.50. There were to be no components near enough to act as heat sinks. Radial deflections were to be measured at the nose-fairing ring and at the adapter ring at Station 232.50.

The loads were actually applied in 20% increments to 100% of the values specified (limit load). At 100% load a slight curvature in the skin panel was observed in the vicinity of the cutout in Quadrant IV between Ring Station 294.08 and Ring Station 283.0. Back-to-back strain gages in this area read minus 775 and minus 50 micro-in./in. strain at 100% load. The load was reduced to 0% and some permanent set was noted.

The load was applied again to 100% of limit load and then increased in 5% increments to 125%. No evidence of failure of any kind was found upon examination of the structure. The curvature in the area of the cutout appeared to be approximately the same as at 100% load. The maximum strain readings in the area of the cutout read minus 110 and +45 micro-in./in. for back-to-back gages at 125% load.

The loads were then applied as specified for the forward-section critical flight condition. The loads were applied in the following increments (%) to failure: 0, 40, 80, 100, 120, 125, 0, 125, 130, 135, 140, and 145. The structure failed just as the load reached 145% of critical flight-condition loads. Skin buckling began between Ring Station 294.08 and Ring Station 283.0 in the vicinity of the cutout in Quadrant IV. Deflection readings of the bending of the skin immediately adjacent to the cutout were measured up to 140% load. The deflection readings increased from 0.075 in. at 135% to 0.225 in. at 140% load. After the initial buckle occurred in the vicinity of the cut, the skin buckling progressed around the periphery in Quadrants III and IV. The maximum-strain gage readings were in the vicinity of the cutout and read minus 1493 and +1016 micro-in./in. for back-to-back gages at 140% load.

The loads and temperatures under simulated booster-burnout conditions were applied at two different rates as shown in Table VII (a and b).



BOOSTER BURNOUT CONDITION LOADS	
P_1	1240 lb
P_2	6568 lb
P_3	2722 lb
P_6	450 lb
P_5	802 lb

Figure 24. Test Loads under Booster Burn-out Conditions

Table VII. a. Booster Burnout Test Condition (First Time Rate)

Time Sec.	Load %	Temperature °F	Remarks
-0	0	RT	Zero readings recorded
-0	20	RT	Initial readings recorded
0	20	RT	Load program started
60	28	RT	Heat program started
120	63	295°, 440°, 610°	All zones reach maximum temp.
133	80	295°, 440°, 610°	80% readings recorded
146	90	295°, 440°, 610°	100% strain readings recorded. Missed thermocouple data
210	100	295°, 440°, 610°	Load reduced to 0%; heat turned off. Test complete

Table VII. b. Booster Burnout Test Condition (Second Time Rate)

Time Sec.	Load %	Temperature °F	Remarks
-0	0	RT	Zero readings recorded.
-0	20	RT	Initial readings recorded.
0	20	RT	Load program started.
60	29	RT	Heat program started.
120	62	295°, 440°, 610°	All zones reached maximum temperature.
145	100	295°, 440°, 610°	Missed readings at this load.
170	110	295°, 440°, 610°	110% readings recorded.
185	120	295°, 440°, 610°	120% readings recorded.
205	125	295°, 440°, 610°	125% readings recorded.
220	125	295°, 440°, 610°	Load reduced to 0%; heat turned off. Test complete.

Test results showed that:

(1) The structure was capable of withstanding 125% of critical flight condition loads.

(2) The forward section would fail by skin buckling between Ring Station 294.08 and Ring Station 283.0 when subjected to 145% of critical flight-condition loads.

(3) The structure was capable of withstanding 125% of booster-burnout-condition loads when subjected to temperatures of 440°F from station 294.08 to 244.50, 295°F from station 244.50 to 232.50, and 610°F from station 232.50 to 208.3.

b. Static tests for Block III. During an informal meeting on May 9, 1964, at LMSC (Sunnyvale), plans were made for a new series of tests in preparation for the Block III flights. LMSC asked for two Ranger spacecraft frames, one for separation tests at Burbank, and one for static tests at Sunnyvale. The static tests were planned to go to destruction. Since JPL could provide only one aluminum bus without jeopardizing the flight schedule, it was decided that if the static tests were conducted after the separation tests, there would be no objection to carrying the static test to destruction.

It was verified that a single load-application point at the spacecraft center of gravity would be a satisfactory simulation of the actual load. The loading desired was equivalent to the spacecraft ultimate-design loading; i.e., 12.5-g axial and 2.5-g radial plus aerodynamic loads and aerodynamic heating effects.

The Block III static tests were held at Sunnyvale during November 5 to 15, 1963, with the following objectives:

(1) To measure the nose-cone and spacecraft support-structure interface ring deflections due to simulated flight temperatures without critical flight loads;

(2) To measure the controlling strains on and deflection of the test structure, due to the application of programmedproportional loads and temperatures simulating critical flight and booster-burnout loading conditions;

(3) To measure the failure values for the loads and the corresponding strains and deflections of the test structure due to programmed proportional loads in excess of the LMSC design ultimate loads;

(4) To measure the strains and deflections as well as temperature differentials incurred by the spacecraft bus during each of the four phases of this test program (temperature only, LMSC limit and ultimate loads, JPL ultimate load), employing a test section comprised of a nose cone, spacecraft, spacecraft adapter, and forward equipment rack;

(5) To measure only the deflections of the spacecraft bus during JPL limit-load applications, with particular attention to the deflection of the solar-panel pivot fittings (Fig. 25).

The full-scale static loading at flight environmental temperature provided information for structural evaluation and qualification of the new lightweight spacecraft adapter (with the fiberglass diaphragm removed), including its interface assemblies with the spacecraft, nose cone, and forward equipment rack. Critical flight-loading conditions were simulated by programmed proportional loads applied to the spacecraft adapter through a spaceframe (spacecraft bus) and a modified nose cone. The above loading occurred during application of flight temperatures in the adapter area. In addition to the test data gathered for evaluating LMSC hardware, JPL obtained additional data with regard to strain and deflection as well as temperature differentials occurring in the spacecraft bus.

c. Results. The test results (Ref. 14) indicated a maximum stress of 15,400 psi. All strains were measured at member locations removed from stress concentrations. Thus, in local areas of stress concentration, the stress levels may have significantly exceeded the maximum value reported above. However, no permanent set was observed in any portion of the spaceframe.

Thermocouple data indicated that there did not appear to be a significant heat transfer across the adapter-spaceframe interface. Thus, heat saturation of the spaceframe was minimal, and the structural integrity of the test structure in a thermal environment under fully developed temperature differentials was satisfactorily established.

The displacement at the tip of the solar-panel support fitting indicated that the tip of the solar panel would displace approximately 0.061 in. as a result of the fitting motion. This assumed rigid-body rotation of the panel only.

A comparison of theoretical and test-load levels indicated that the test levels were generally higher; they were, therefore, more conservative in each test phase than the theoretical levels.

2. Dynamic

a. Separation. In order to determine the dynamic compatibility of each of the two separation sequences, a comprehensive series of analyses and tests was begun in August 1960.

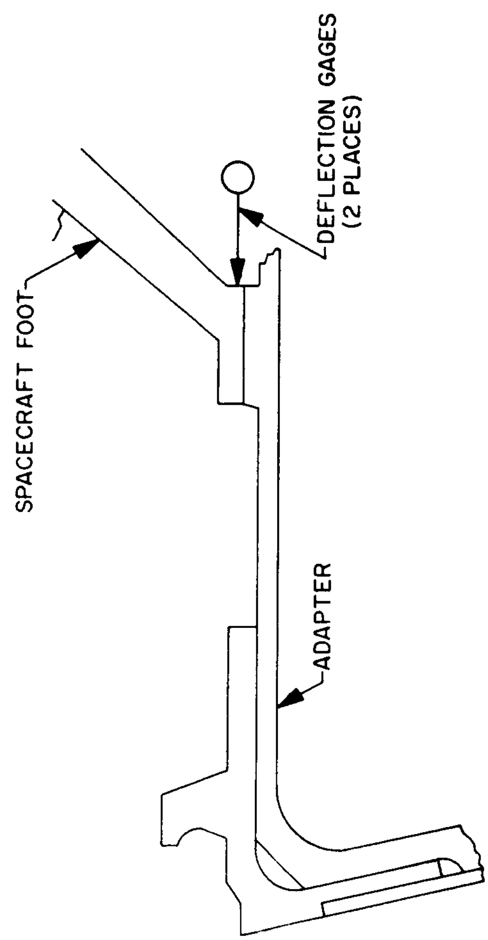


Figure 25. Spacecraft Deflections During Static Loading Tests

For expediency and clarity, all nose-fairing and spacecraft-separation tests were programmed together, excluding other testing. Charts were prepared depicting the program, test dates, hardware required, location of tests, and other pertinent information. A similar test plan for the remainder of compatibility testing including static, vibration, pressure, and temperature effects was also prepared.

(1) Requirements and Analyses

(a) Shroud Separation. One early requirement for verification of the shroud-separation performance was the fulfillment of NASA Task Assignment Directive 002. LMSD performed the basic study and analysis of the system while following two fundamental design requirements as guidelines (Ref. 1). These were, first, that the shroud was not to contact the spacecraft during the ejection, and second, that the Agena was not to contact the shroud during the post-ejection descent of the shroud.

The first requirement became the basis for Phase I of the study. The effects of five principal sources of clearance reduction between the shroud and payload were considered to be present simultaneously, and were listed as residual rates (from initial angular velocities of the Atlas/Agena/shroud combination). These effects were spring imbalance, center-of-gravity offset, failure of one of the two retrorockets to ignite, and early activation of Agena attitude control.

Eight springs which imparted a 6-ft/sec ejection velocity to the shroud were used. These springs had a spring constant per-unit-extension of 15.8 lb/in. per spring, and a useful extension of 3.8 in./spring. The shroud assumed to weight 140 lb and to have a moment-of-inertia of 64.6 slug-ft squared about any transverse axis. It was pointed out that the ejection velocity varied in discrete steps, i.e., the whole number of springs had to be used. The Model 4205 springs were used because they were readily available and had been qualified. Arbitrarily, a point on the payload envelope at the separation plane was called the trace point. Although it was located 31 in. off the longitudinal axis and slightly inboard of the actual base of the shroud, the point would be considered attached to the shroud. Fig. 26 shows the trace point of the shroud as it moved past the payload envelope. This procedure resulted in a conservative estimate of shroud/payload clearance.

The initial angular velocities for the Atlas/Agena/shroud combination prior to shroud ejection had a maximum specified value of one deg/sec simultaneously about all three axes. These residual rates, when coupled with the ejection velocity, gave a Coriolis acceleration of the shroud trace point relative to the longitudinal axis of the vehicle, the resulting transverse motion of the point was determined to be a parabolic

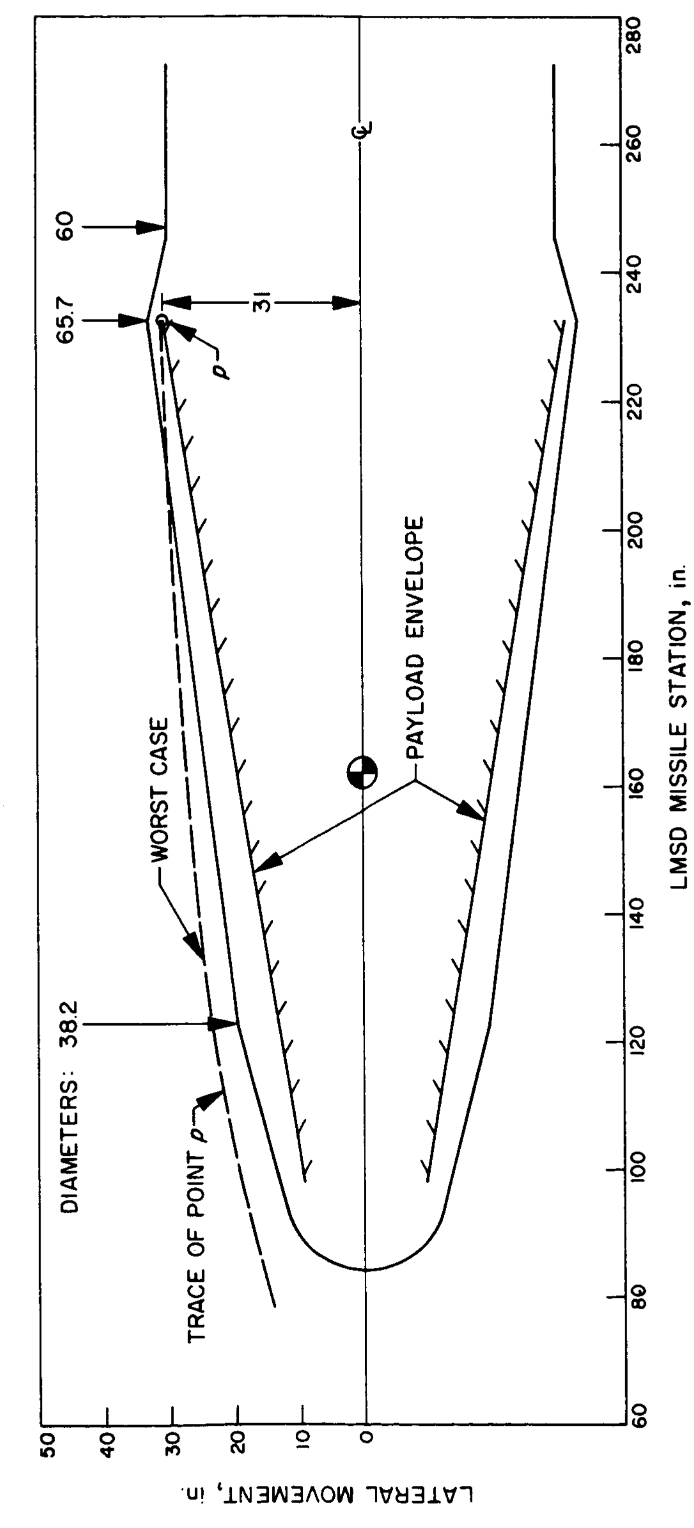


Figure 26. Shroud/Spacecraft Relative Motion

function of time. When it passed through the nose station transverse plane, the point was 7.9 in. closer to the longitudinal axis because of the effects of initial rotational rates.

The spring force unbalance caused by spring-constant tolerance of 0.2 lb/in. per spring,combined, in the worst case, to impart an angular velocity of 0.8 deg/sec to the shroud. The resulting relative motion of the shroud was a linear function of time. Due to the spring unbalance, the shroud trace point was 2.1 in. closer to the longitudinal axis when it passed through the nose-station transverse plane. The shroud trace point was found to be 2.1 in. closer to the longitudinal axis when it passed through the nose-station transverse plane because of the center-of-gravity offset.

The combination of the following effects resulted in acceleration of the Atlas/Agena to an angular velocity of 0.1 deg/sec: (1) ignition of only one of the two Atlas retrorockets; (2) a high impulse of 500 lb/sec for the one rocket; (3) a burn time of only 0.5 sec; and (4) a 1-deg misalignment of the rocket from the optimum direction.

The retrorockets mounted on the Atlas/Agena adapter section were not to be aligned to a point through the center of gravity of the Atlas/Agena vehicle at the instant of separation, but considerably forward of it. The alignment was determined by dynamic considerations in order to minimize the force on the separation rails due to the excitation of the natural bending modes of the Atlas/Agena.

With both Atlas retrorockets giving maximum impulse in minimum burn time to a minimum-weight Atlas, it was found that the Agena would separate from the Atlas before the shroud had cleared the payload. The Agena attitude-control system could then have started torquing the Agena at the maximum angular acceleration of 1.22 deg/sec^2. This effect by itself could have resulted in the shroud trace point being 1.0 in. closer to the longitudinal axis when it passed through the nose-station transverse plane.

When all five principal sources were considered to be present simultaneously, the effects would be superimposed; in the worst case, the shroud trace point would then have been 14.7 in. closer to the longitudinal axis as it passed through the nose-station transverse plane, with the minimum clearance conservatively taken as defined above (Fig. 26). This was an unduly pessimistic approach, as these five sources were actually independent. The root-sum-square of these five effects yielded the motion of the trace point to be only 8.6 in. closer to the longitudinal axis as it passed through the nose-station transverse plane.

Phase II in the study was accomplished to ensure that subsequent to ignition adequate clearance was maintained between the Agena and the shroud as the Agena accelerated past the shroud.

This phase of the study showed that the shroud was ejected simultaneously with the initiation of Atlas/Agena separation 3.0 sec after Atlas VECO at an attitude of 12 deg. The uncertainty in attitude was 0.5 deg, and the ejection velocity at least 6 ft/sec. Agena nominal ignition occurred 34 sec after shroud ejection, with the thrust attitude maintained at 0.2 deg and the thrust acceleration maintained at 1 g during the time of interest. Earliest Agena ignition could have occurred 22 sec after shroud ejection and the maximum-thrust attitude error could have been 0.6 deg.

Initial Atlas/Agena/shroud rotational velocities of 1 deg/sec about all three axes were considered. Their effect on the shroud was found to impart a component of velocity normal to the longitudinal axis of 0.61 ft/sec; to change the ejection angle by 3.0 deg due to the 3-sec delay between VECO and ejection; and to cause the shroud to tumble at 1 deg/sec after ejection. Their effect on the Agena was to impart a normal velocity of 0.35 ft/sec. The net normal velocity of the shroud relative to the Agena was 0.26 ft/sec.

The effect of spring unbalance was to impart an angular velocity to the shroud and to rotate the direction of the ejection velocity. The angular velocity was 0.8 deg/sec. The change in ejection angle was small (less than 0.05 deg) and was difficult to calculate because of the spring lateral slippage involved.

The effect of shroud center-of-gravity offset was to permit the springs to impart an angular velocity of 0.8 deg/sec to the shroud. There would be some slight change in the ejection attitude, but this would be of the same order of magnitude as the effect of spring unbalance.

With only one Atlas retrorocket igniting, an angular velocity of 0.1 deg/sec could have been imparted to the Agena via the rails (but not to the shroud) plus a normal velocity due to this rotation. In addition, the functioning of only one retrorocket would have produced an uncompensated translational force acting in the normal direction. This would have resulted in a translational normal velocity being imparted to both the Atlas and the Agena. Because of the geometry of the Atlas/Agena/retrorocket configuration, the translational normal velocity due to the translational force balanced the normal velocity resulting from the rotational effect.

The computation of the Agena shroud clearance was found by the equation:

$$(CL)_{Shroud/Agena} = \Delta z_p - r_{Agena} - r_{Shroud}$$

where

$(CL)_{Shroud/Agena}$ = Clearance between the assumed Agena and shroud envelopes

Δz_p = Vertical separation of the Agena and shroud cg's at the time the Agena passes the shroud

r_{Agena} = Radius of Agena envelope = 3 feet

r_{Shroud} = Radius of shroud envelope = 6.5 feet

With the nominal values listed below the clearance was found to be 40.5 feet.

t_c	= 34 sec	Coast time (time from command ejection of shroud to Agena Ignition)
V_{ej}	= 6 ft/sec	Initial velocity of shroud relative to Agena, measured along Agena Centerline
θ_{ej}	= 12°	Angle of V_{ej} relative to the horizontal
$\left.Z_s\right]_o$	= 3 ft	Initial vertical coordinate of shroud c.g.
θ_T	= 0.2°	Angle of Agena thrust relative to the horizontal
V_N	= 0	Velocity of shroud normal to V_{ej}, measured relative to the unaccelerated Agena c.g.
z_p	= 50 feet	Vertical separation of shroud and Agena c.g.s at time of passing

Results of the Phase II study are shown in Table VIII. The root-sum-square effect on the clearance was 23.3 ft. Subtraction of this from the 40.5 ft nominal clearance showed the 3-σ minimum clearance to be 17.2 ft (Ref. 15).

Clearances obtained from the above study indicated that the mechanization chosen for shroud ejection was satisfactory.

Table VIII. Effect of Independent Error Sources on Shroud/ Agena Clearance

Source	3 Sigma Uncertainty	Effect on Clearance, Ft	Root-sum-square Effect
Variation in Sustainer Cutoff Time	2 sec	2.5	6.25
Variation in Vernier Cutoff Time	5 sec	6.3	39.8
Variation in Agena Ignition Time	5 sec	6.3	39.8
Error in Initial Atlas/Agena Angle	0.5 deg	1.93	3.73
Atlas/Agena Residual Rate	1 deg/sec	21.2	450
Error in Agena Thrust Attitude	0.6 deg	2.36	5.6
			545.18

(2) Test Techniques and Results. The separation-test program was carefully planned, and detailed schedules were prepared (Fig. 29) for the period January to March 1961. Two sets of test hardware, consisting of yoke assemblies for shroud and spacecraft, were provided in order to conduct simultaneous tests, thereby avoiding delays in the test schedule.

A long-pendulum technique was used in the separation tests. Initial conferences indicated the use of a pendulum of 60-ft minimum length. Building 360 at CALAC was chosen as the test site. Three 65-ft pendulums were suspended approximately 15 ft apart in a draft-free enclosed area, and three "strong backs" were erected to support the aft end of the spacecraft and to accept the adapter. Test hardware, instrumentation, and camera placement were designed so that the three tests could be conducted simultaneously.

Test results were presented in three documents (Ref. 18, 19, and 20). The data were reduced from films taken with high-speed cameras which recorded the motion of the separating body and from the oscillograph which recorded applied forces and various event times.

After the above studies had been completed, two additional factors were suspected of influencing shroud motion. These factors were the late firing of one pin-puller and the force due to Atlas/Agena pull-away disconnect. Results of these additional effects in combination with results of the previous work were presented in Ref. 16. The additional factors changed the shroud-payload clearance, but Phase II of the previous study was not affected (Fig. 27).

(b) Spacecraft separation. Spacecraft separation from the Agena was evaluated as a result of NASA TAD 003. The analysis determined relative motion during ejection, with special attention being paid to the linear and angular rates of the spacecraft. The separation velocity, ΔV, was obtained by using the spacecraft ejection springs (Ref. 17). Requirements were established for the separation process in order to ensure compliance with design goals.

It was determined that the spacecraft should be ejected with a minimum separation velocity of at least 1/2 (0.5) ft/sec. This velocity was high enough to ensure positive separation, but low enough to make the use of more complicated techniques unnecessary. Ejection dynamics and design considerations indicated that the springs and spring-type mechanization available could be used to meet the above requirement. It was recommended that steps be taken to ensure that the springs remain with the Agena to prevent possible future collision with the spacecraft or interference with its magnetometer.

It was also found that the spacecraft should be ejected at the same attitude, with respect to the local horizontal, as that used during the Agena second burn. The trajectory flight path at the time of ejection would be less than 5 deg above the local horizontal (Fig. 28); thus, an Agena maneuver to align the ejection-velocity vector more closely to the trajectory-velocity vector would not be necessary.

Agena/spacecraft separation would have to be delayed at least 60 sec after Agena second-burn burnout. From propulsion characteristics it was estimated that the residual thrust following Agena second-burn guidance shutoff would be negligible 10 sec after shutoff. The 60-sec minimum delay was conservative and was intended to allow for any anomalies associated with residual thrust. The spacecraft post-injection requirements did not dictate an earlier separation; there would be sufficient time remaining on the ascent timer to accommodate this delay. Ample electrical power and control gas would remain for Agena attitude-control system operation.

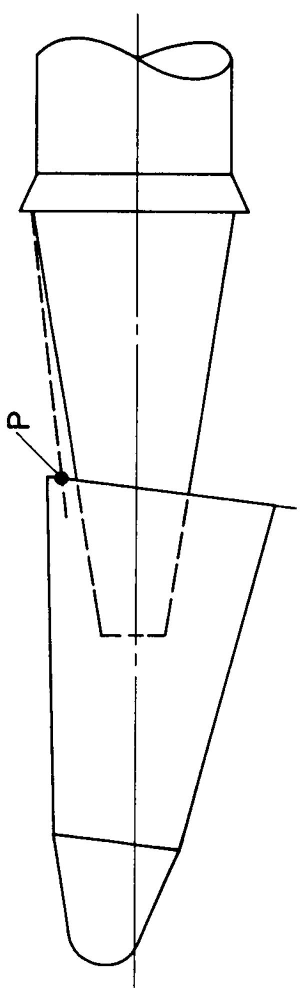


Figure 27. Shroud Separation with Late Firing of One Pin-Puller

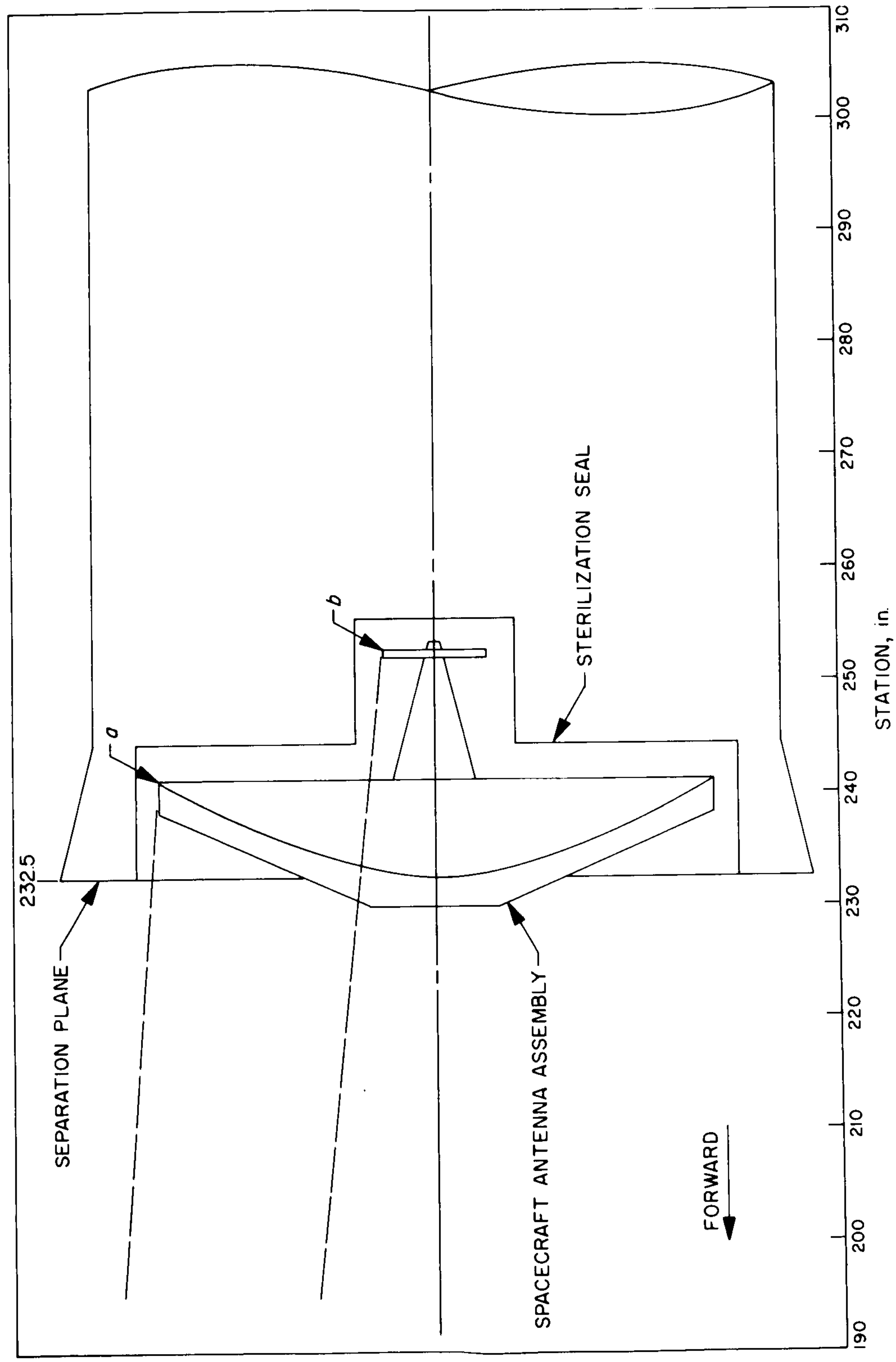


Figure 28. Spacecraft Agena Separation

The pendulum technique was selected as most suitable for conduction of the separation tests, in spite of certain inherently undesirable characteristics. These characteristics, which had to be taken into account, were that roll was essentially prohibited, and pitch was limited by the cable. The separating body could not move vertically out of the arc path of the pendulum without elongating or shortening the cable; consequently it experienced a variable supporting force due to the cable spring rate.

A vertical oscillation of this spring-mass system resulted and motions that should have appeared due to separation perturbations were prevented. In addition, a pitch rate and attitude were produced by the descent of the CG as it swung away from the adapter, since the center of the aft end of the body was restricted by the plungers so that it would remain on the roll axis. In the case of the shroud, the plunger loads were great enough to prevent slippage between them and the shroud ring; on the spacecraft the sockets in the shear tie feet retained the plungers, so that JPL Station 500. 00 was held centered on the roll axis. These effects were variable and non-linear, so they were not amenable to isolation during data reduction.

In yaw, the test was practically free from the pendulum effect. Pendulum rise due to lateral displacement was on the order of millionths of an inch, causing a lateral velocity degradation of less than 0. 1 in/sec small enough to disregard.

(a) Shroud-separation tests. The nose-cone separation tests consisted of five phases.

(1) Center-of-gravity tests were run to establish what effect the pendulum support system had on the test results. Known forces and couples were applied to the nose cone and the resulting motion was compared with theory.

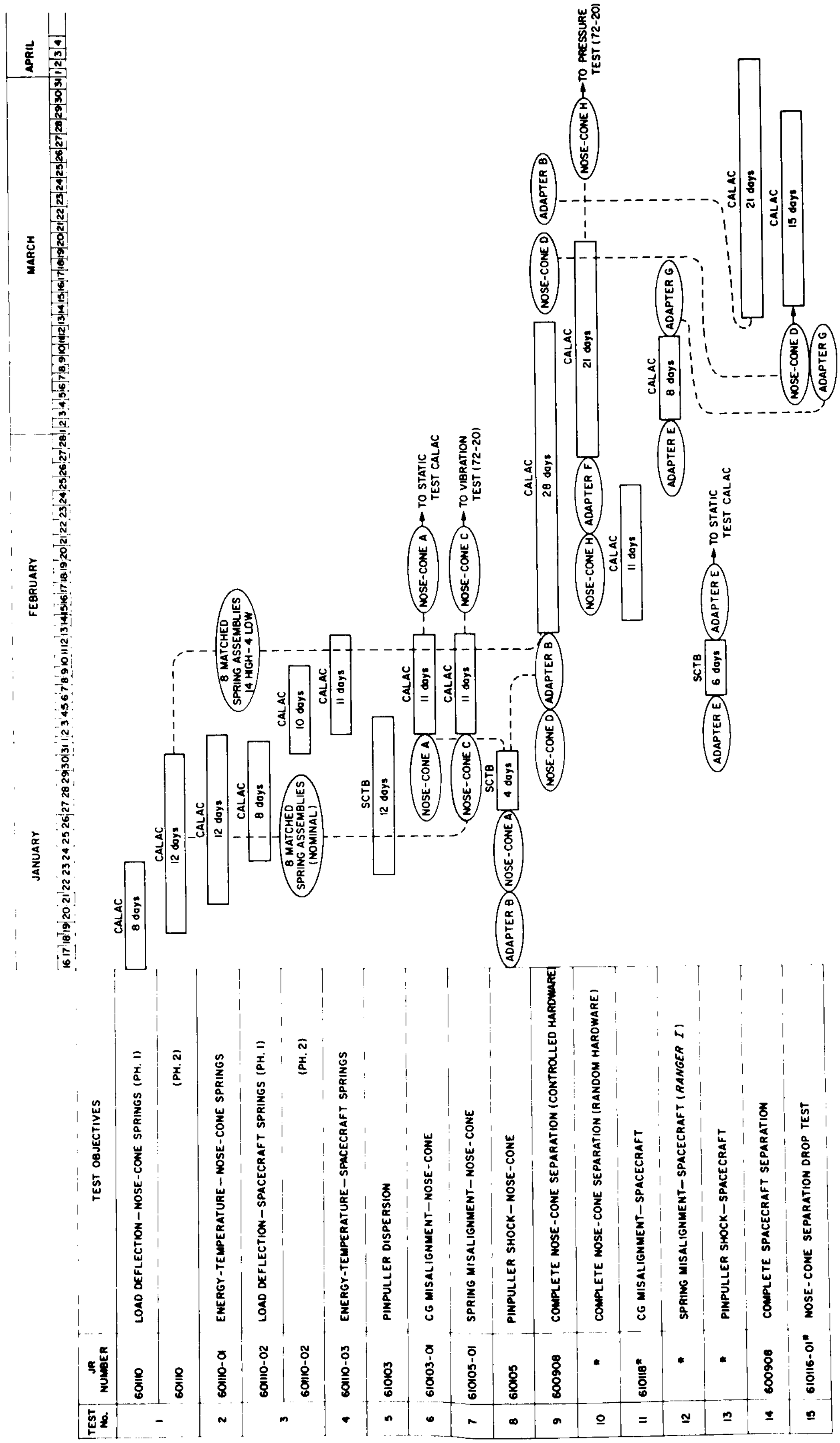
(2) In the spring misalignment tests the isolated effects of spring rate tolerance, spring stroke, and housing alignment were investigated.

(3) A shroud with complete hardware was used in the controlled-hardware tests; the effects of hardware parameters set at their extreme tolerance were investigated.

(4) The purpose of the pinpuller shock tests was to study the effect of a sudden release of the tension ties, which anchored the shroud, occurring in conjunction with the firing of the pinpullers.

(5) The random hardware tests were run to determine if successful separation could be achieved when the separation-system hardware was installed in a random manner.

Analysis of the nose-cone CG misalignment data involved comparisons of measured displacements and velocities with theoretical values. The theoretical values were calculated using a two-dimensional rigid-body model where the mass of the system was assumed to be that of the nose cone plus the support



*ENGINEERING TO BE RELEASED

Figure 29. Separation Test Program

yoke. The effective mass of the cable was shown to be insignificant and was therefore neglected in the analysis. The yaw moment of inertia used was that of the nose cone-yoke system.

Results from the spring misalignment tests were presented in tabular form so that the effects of varying the spring mechanism parameters could be readily noted and compared. Both the controlled and random hardware data were analyzed from a clearance point of view. The linear-velocity data was modified to account for the added mass of the yoke support, and clearance reductions were calculated both with and without data error.

Pinpuller shock results were read from the data in the form of induced linear velocity and angular rates. These were tabulated, correcting the linear velocity for yoke mass.

(b) Spacecraft-separation tests. The spacecraft-separation tests were conducted in two phases: CG tests like those run with the nose cone were conducted to establish the effect the support system had on the test results; and controlled hardware tests were made in order to establish what effect separation parameter tolerance had on separation.

The spacecraft CG-misalignment test-data analysis was similar to that used for the nose cone in that comparisons of linear velocity, angular positions, and angular rates were made with theory. Again, as with the shroud, a two-dimensional model was used for the theoretical calculations. A viscous damping term was included in the rotational equation to account for the damping effect of the pendulum support system, and it was possible to match the angular-position and angular-rate data with theory quite well by this method. The JPL simulated spacecraft and the support yoke were assumed to constitute the mass of the system. The moments of inertia measured by CALAC test engineering were used; the yaw moment of inertia was measured with the support yoke attached.

In the controlled hardware analysis, clearance reductions were calculated and maximum induced angular rates at separation from tabulated test data were noted. Test results indicated that the separation systems for the shroud and spacecraft would perform satisfactorily and that separation could be achieved.

Block III spacecraft-separation tests were performed in September and October 1963 to ensure that there would be no undesirable change in separation characteristics because of the recent modifications. These modifications were: (1) removal of the sterilization diaphragm from the adapter; (2) addition of bracketry and shielding to compensate for removal of the diaphragm; (3) change in structural material in the spacecraft bus from magnesium to aluminum; (4) addition of two pads to resist backup timers on the spacecraft; and (5) increase in preload between the adapter and spacecraft feet (Ref. 23).

Results of the Ranger Block III separation tests showed that the maximum rotational rate observed represented an equivalent in-flight tipoff rate of 2.49 deg/sec. It was determined that with the JPL timer and switches added, the tipoff rate would not exceed 3.0 deg/sec, and that the Ranger spacecraft would separate from the Agena with a relative velocity of at least 18.84 in./sec. With the Block III design there would be no possibility of the spacecraft striking the adapter during separation (Ref. 22).

b. Vibration. The spacecraft, Agena B adapter, and shroud were assembled as a unit (Ref. 23). Composite vibration tests, initiated in February 1961, were used to determine the structural integrity under vibrational excitation, and to verify that the dynamic excursions of the spacecraft and shroud remained within their respective envelopes throughout the frequency spectrum of the test.

The first composite vibration test (Ranger I configuration) demonstrated that the response of the spacecraft was not significantly altered either by the dynamic characteristics of the adapter or by deformation of the adapter caused by the dynamic loading of the shroud. In the second test (Ranger III configuration) this result was confirmed, in that the response of the spacecraft was essentially independent of the presence of the adapter and shroud. The tests also confirmed that the shroud remained within its dynamic envelope.

It was concluded that, for each spacecraft configuration, the envelope of its dynamic excursions could be analytically predicted and the results checked by a test of the spacecraft alone. If analysis or testing of a spacecraft configuration indicated that a possible dynamic interference existed, or if the shroud-adapter system was to be extensively revised, JPL would request a complete composite vibration test.

Plans for a new series of structural vibration tests were initiated in March 1963 (Ref. 24). The objectives of the new tests were:

(1) To determine the effects of vibration on the behavior of a spacecraft (with the Ranger Block III configuration and weight); in this test the unit was mounted on

two types of Agena adapters, one with a sterilization diaphragm (Ranger adapter), and one without the diaphragm (Mariner Venus adapter).

(2) To determine the transfer functions of input frequencies across each type of adapter.

(3) To determine the change in loads in the intercostal tubes of the Ranger, due to decreased rigidity of the adapter without a diaphragm, when subjected to vibration.

The mechanical test model (MTM) for the cancelled Ranger Follow-On program was used for the spacecraft test and this MTM was weighted to the Ranger Block III design weight (808 lb). The Ranger adapter EM 988 and the Mariner adapter available at JPL were employed. LMSC mating hardware was used, first in strict accordance with the conditions of Lockheed Design Specification 1410296-B and JPL Procedure P53-55R 114.00, and later, when questions of actual shear-feet preload arose, under preload conditions modified by specific characteristics of the load washers.

Six tests were performed in the following order: (Ref. 25).

Lateral X, Ranger adapter
Lateral Y, Ranger adapter
Lateral X, Mariner Venus adapter
Lateral Y, Mariner Venus adapter
Torsional, Ranger adapter
Torsional, Mariner Venus adapter

For the X and Y shake directions, the assemblies were subjected to sinusoidal vibration at frequencies between 5 and 80 cps for a total elapsed time of 6 min. The sweep was such that the time rate of change of frequency increased directly with frequency. Input acceleration amplitude was controlled by servo to 0.5-g rms, measured in the direction of shake at the adapter side of the separation plane by spacecraft station 500. The rms outputs of two accelerometers mounted in this plane were averaged, and this average was used as the servo input.

Input was force-limited to a maximum of 2000 lb, with diminishing input accelerations at spacecraft resonances. Two similar runs for each test, designated by "a" and "b", were required to record the desired dynamic information.

The torsional shakes were run at two different levels, preliminary and final.

The spacecraft with each adapter was subjected to a preliminary-level sinusoidal vibration at frequencies between 20 and 150 cps for a total elapsed time of 4.5 min. The sweep was such that the time rate of change of frequency increased directly with frequency. Input acceleration amplitude for each sweep was 0.5-g rms, measured on the fixture below the adapters at a radius of 30.62 in. from the spacecraft roll axis.

All assemblies were subjected to a final-level sinusoidal vibration at frequencies between 20 and 150 cps for a total time of 9 min, together with two pulses, one at the beginning of the sweep and one at the end of the sweep. The details were as follows:

Pulse (Fig. 30)
Sweep from 20 to 150 cps in 4.5 min.
Sweep from 150 to 20 cps in 4.5 min.
Pulse (Fig. 30)

The sweeps for the final level again were such that the time rate of change of frequency increased directly with frequency and the pulse was a69-cps tone that was amplitude-modulated with a 2.5-cps sine wave whose angular amplitude was 154.4 rad/sec^2.

Input acceleration amplitude for the sweep portions of the tests was 1.0-g rms for the spacecraft/Ranger adapter assembly, and 0.75-g rms for the spacecraft/ Mariner Venus adapter assembly. Both of these inputs were measured on the fixture below the adapters at a radius of 30.62 in. from the spacecraft roll axis.

For all torsional tests, the input acceleration amplitude was servo-controlled. The rms outputs of two opposite accelerometers were averaged and this average was used as the servo input. All desired dynamic information was recorded during the tests at preliminary levels and final levels.

Data reduction was done by the JPL Data Analysis Laboratory by use of a low-frequency spectrum analysis in the line-spectrum mode. The foremost problem encountered in the series of lateral tests was chattering of the shear feet; it occurred in both X and Y vibration tests in a wide range of frequencies around first and second bending-mode resonances. The compressive loads at the shear feet, which were made up of the nominal 200-lb preload plus that part of the weight of the spacecraft reacting at the shear feet, were overcome by dynamic overturning moments. It was initially thought that the shear feet separated because the preload was less than the specified 200 lb. To find what preload actually existed during the vibration tests, an after-the-fact test was run. Load washers were installed at feet B, D, and F, and spacers were installed at the tension feet to give a constant upward translation of the spacecraft, relative to the adapter, of 1/4 in. This installation did not disturb the relative mating dimensions that existed during the vibration tests. With the spacecraft mated to the

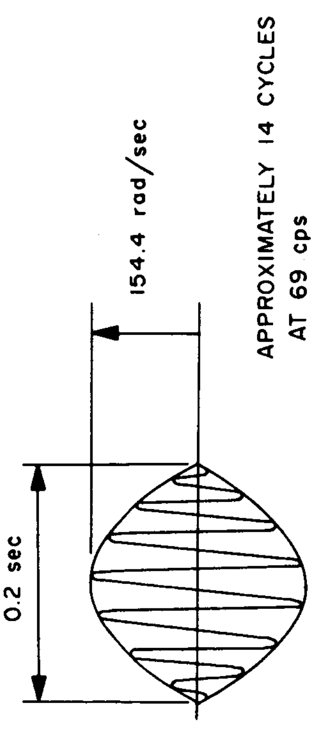


Figure 30. Vibration Test Pulse

adapter exactly as it had been for shake, except for 1/4 in.additional spacers at all 6 feet, compressive loads at the shear feet were recorded.

FOOT	LOAD, lb	*PRELOAD, lb
B	334	200
D	279	145
F	270	136

*Load minus spacecraft weight/6

Feet D and F were found to be loaded incorrectly. However, if the input were doubled, as it would be for a type-approval (TA) test, doubling the preloads would not have been sufficient to prevent separation of the feet. An analysis showed that the nominal 200-lb preload was insufficient to prevent chatter even at the preliminary test levels.

There were several effects of shear-feet chatter. Separation of the shear feet from their mating cones during part of each periodic cycle of vibration caused a definite nonlinearity in the separation-plane stiffness. This nonlinearity was thought to be the cause of severe beating witnessed both during the test and in the acceleration and strain-gage records. Acceleration output waveforms from instruments in the area of the separation plane clearly indicated chatter of the shear feet by spikes and associated high-frequency ringout. Higher in the structure, this hammering was filtered out by the structure, but the beating phenomenon was still seen.

Chattering and beating during lateral tests destroyed the accuracy of the fundamental harmonic acceleration component plots vs frequency in the areas of resonances (the areas of major interest). This, plus a widely varying fundamental component of input acceleration, led to many inconsistent results in the transfer functions of frequency between the input points and other points in the structure.

During torsional tests, the bending modes were not appreciably excited, and since dynamic overturning moments were low, shear-feet chatter did not occur.

The natural frequencies associated with normal modes of the spacecraft and adapters were experimentally found to be:

	Axis	Ranger Adapter cps	Mariner Venus Adapter cps
First Bending	X	22	22
Second Bending	X	40	37
First Bending	Y	25	22
Second Bending	Y	53	50
Torsional		43	36

The high readings on the top of the bus in the torsional test were thought to be due to local effects of the solar panel "rabbit ear" supports as the solar panels were quite active at these frequencies.

Strains recorded in the intercostal tubes did not follow a definite pattern from one adapter to the other. On an overall average, stresses were about 17% higher when the spacecraft was mounted on the Mariner Venus adapter. However, the maximum strain recorded at any time in any intercostal tube occurred when the Ranger adapter was used.

Transfer functions across both adapters for lateral tests and for torsional tests were plotted. Fig. 31 shows the torsional transfer functions. It was interesting that the peak responses across the adapters did not occur at the spacecraft-adapter resonances, and it was concluded that these must be local resonances of the adapters.

Response to the torsional pulse was practically unobservable when the pulse was input at the base of both adapters. Direct-write records showed that the transfer functions were less than one, and no further reduction of pulse data was made. It was possible that the time constant in the direct-write machine was too long to allow response to the 0.2-sec pulse.

Conclusions

Based on strain-gage readings, accelerometer data, and visual observations of the spacecraft vibration tests made on both adapters, it was generally concluded from the tests that there would be no structural problem in either the spacecraft or in the adapters. Because of the similarity of normal modes and frequencies (with the exception of torsional modes and frequencies), between the Ranger MTM and the Ranger Block III, the decision to use the Mariner Venus type adapter without a sterilization diaphragm for the Block III program appeared to be a sound one. However, it was recommended that a torsional test on a Ranger Block III vehicle mounted to an adapter without a diaphragm be performed.

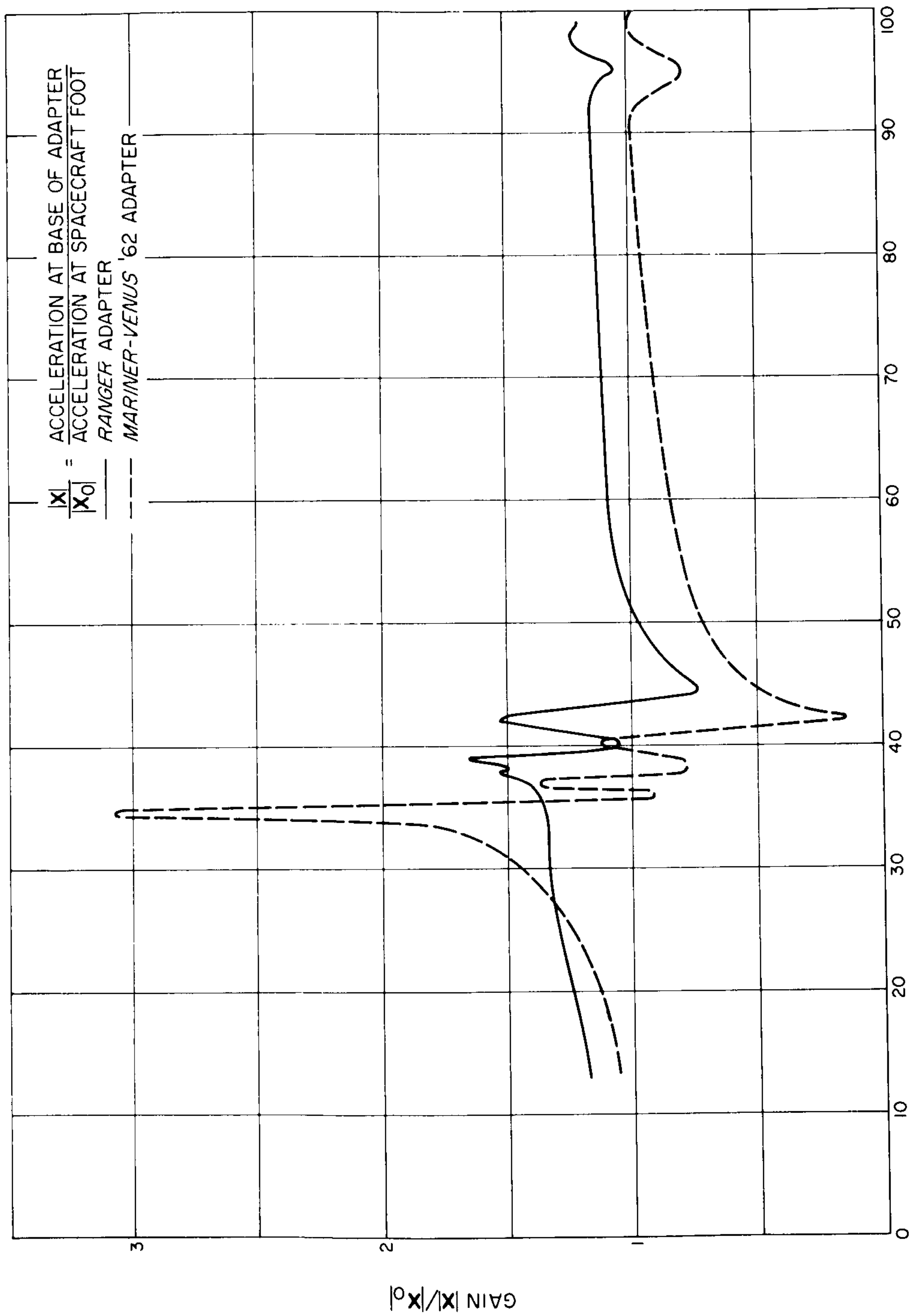


Figure 31. Torsional Vibration Transfer Functions

A simplified analysis indicated that, for a type-approval level lateral test, dynamic overturning moments would cause foot separation at preloads less than approximately 2500 lb. This preload seemed much too high, and it appeared that the analysis did not include enough factors. It was therefore decided that further testing would be required either to confirm or to discredit the analysis and to find what preload was necessary to prevent shear-foot chatter. Later, during the Structural Vibration Tests of the Ranger Block III STM, shear feet also chattered with preloads of approximately 650 lb between the spacecraft and a rigid vibration fixture. During the lateral Y test, inputs were approximately 50% of the 1-g rms required for type approval, indicating that preloads would have to be greater than 1300 lb in order to prevent chatter. This fact appeared to confirm the analysis and it was decided to preload to a value that would obviously allow chatter under sinusoidal-type approval testing.

c. Shock Tests

(1) Tests prior to Ranger I flight. The shock environment of the Ranger spacecraft due to activation of the Lockheed pyrotechnic pinpullers was investigated in August 1960. In addition to the primary purpose of determining shock levels, the Type Approval (TA) unit of the Earth sensor was installed on the spacecraft (Ref. 26) to serve as a typical unit whose performance during shock would give an indication of reliable operation.

The test assembly consisted of the PTM adapter and the dynamic model of Ranger I; the spacecraft was instrumented with a total of eighteen accelerometers (one Statham and seventeen Endevco). A mockup of the Earth sensor was used during the formal test. Preliminary tests were made to determine the appropriate recording levels. All signals were recorded on magnetic tape and oscillograph paper.

The three pinpullers were fired as they would have been during normal spacecraft separation, and the overall response of the spacecraft was measured and recorded.

Results of the tests indicated that the measured g-level responses below 3 kc were adequately covered by the shock tests in JPL Specification 30201. The actual results above 3 kc were not adequately simulated by the specification. It was found to be impossible to specify a shock test to simulate the high-frequency environment because almost nothing was known about mounting-fixture transfer characteristics above 3 kc. Results of the tests are shown in Fig. 32, which also shows two shock spectra from JPL Specification 30201. The actual test results were expected to fall somewhere between these two limits, but it was determined that, at the higher frequencies, some of the levels were outside the test limits.

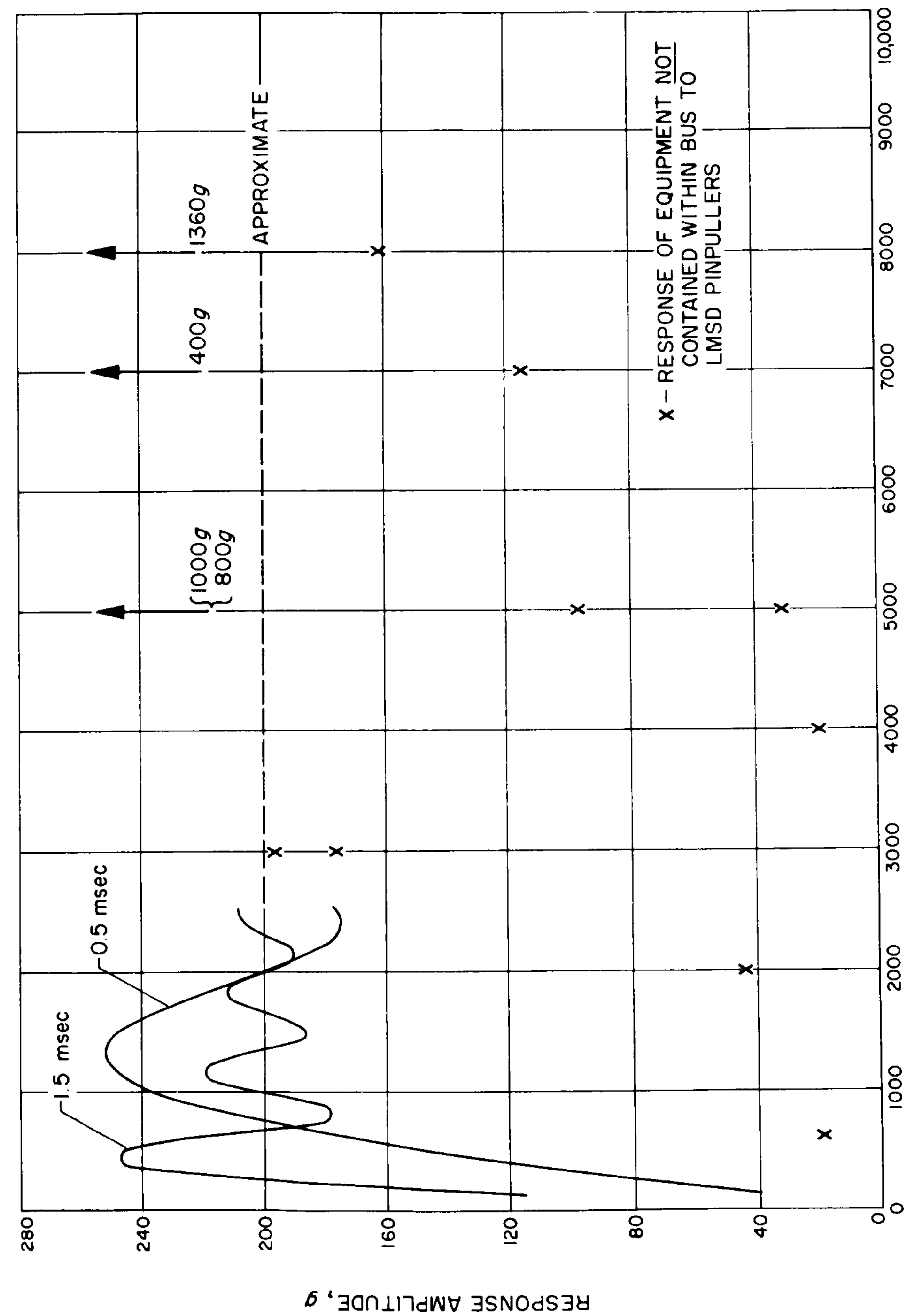


Figure 32. Theoretical Spectrum of Shock Test

The high-frequency responses caused by the pinpullers were not believed to be detrimental to the operation of spacecraft equipment, however this could not be demonstrated at the assembly level. The most valid test, therefore, was to fire the LMSC pinpullers in the adapter with the actual flight spacecraft in place. This would simulate flight conditions very closely, but would not allow for margins and would not provide confidence in operations performed under slightly different conditions.

Although, strictly speaking, the Earth sensor did not fail the test, it did exhibit certain deviations in performance after the pinpuller firing. The Earth sensor was the only operating item of equipment used in the test, but the results indicated the general nature of the difficulties which could be expected from the shock of separation.

(2) Ranger V pyrotechnics tests. The shock environment produced by the actuation of pyrotechnics devices was measured at various spacecraft locations during the dummy run of Ranger V (Ref. 27), and it was found that the structural responses were comparable to previous measurements in both magnitude and frequency. The g-levels were relatively high for some of the high-frequency components of shock, but these were believed to have little damaging capability.

A dummy run was conducted with an assembly consisting of the Ranger V spacecraft, the Agena adapter, and the nose fairing. Twelve accelerometers were located at various places on the spacecraft bus to record data during the following events: spacecraft separation (LMSC pinpullers), solar-panel deployment, gamma-ray boom extension, altimeter and vidicon cover deployment, and mini-antenna and redundant vidicon cover deployment.

All spacecraft systems that were to operate during the launch mode were monitored for possible deleterious transients, and a systems test was performed afterward to detect any permanent damage. The gear box, as anticipated, displayed a high shock reading when the Lockheed pinpullers were fired. In all cases, however, the frequency components below 2 kc were lower than the levels used in TA tests.

The results of the test verified the adquacy of shock test levels and tended to indicate that high-frequency response caused no permanent damage to spacecraft components.

(3) Ranger VI pyrotechnics test. The shock test specified in JPL Specification RCO-50107-FAT was performed September 11, 1963, JPL (Ref. 28). No abnormal indications were noted on the spacecraft during shock pulses. The shock environment produced by the actuation of the electrical disconnects, Agena/spacecraft separation pinpullers, and solar-panel pinpullers was measured at various spacecraft locations. The structural responses recorded were comparable to past measurements.

The spacecraft was mated to Agena adapter S/N 988 (full diaphragm configuration), and the spring assembly, used to pull the male plug of the electrical disconnects away from the spacecraft, was installed. Twelve accelerometers were mounted on the spacecraft, and Fastax pictures recorded the actuation of the electrical disconnects.

Shock data was recorded during the following events: electrical disconnect, spacecraft separation, and solar-panel deployment. Data was recorded on tape at 60 ips. A 10-kc oscillator reference was also recorded to provide a timing reference for playback. All spacecraft systems that normally operated during the pyrotechnics events were monitored.

The Fastax pictures revealed that one of the firing pins of the electrical disconnect (plug J2) did not clear the plug and that it struck the cannon barrel. A visual examination of the spacecraft plug indicated no damage. No abnormal indications were noted on the operation of spacecraft systems during pyrotechnics events.

(4) Pyrotechnics tests on spacecraft adapter. As a result of an inspection report (Ref. 29) in which it was stated that an Agena flight adapter was apparently contaminated by the firing of pyrotechnics, JPL reviewed the test philosophy connected with pyrotechnics tests. It was verified that the essential purpose of the tests was to simulate the shock associated with the firing of pyrotechnics, and the primary objective was to ensure that spacecraft systems functioned properly in the shock environment (Ref. 30). The pyrotechnics were used only as a mechanism to produce the environment.

For the separation pinpuller tests (LMSC separation pinpullers), a dynamically similar mockup of the adapter would be required to produce the environment adequately. Since the test would not require the use of the flight adapter, and since LMSC would not permit utilization of the adapter for pyrotechnics tests, it was determined that JPL would use a dynamically similar adapter for the tests.

(5) Block III PTM pyrotechnics tests (Pre RA-6). The shock tests specified in JPL Specification RCO-50071 ETS were performed during the period of August 10, 1963, to January 2, 1964 (Ref. 31). The tests were run in four phases: Phase I-extension system with live pyrotechnics, separation pinpullers and solar-panel pinpullers; Phase II solar-panel pinpullers following vibration; Phase III - solar-panel pinpullers in vacuum; and Phase IV - midcourse valves following thermal-vacuum testing.

No abnormal indications were noted on the spacecraft during the pyrotechnic shock pulses. The environment produced by the pyrotechnics was measured at various spacecraft locations and the structural responses recorded were comparable in both magnitude and frequency to past measurements.

Data was recorded on tape at 60 ips, and a 10-kc oscillator reference was recorded to provide a timing reference for playback. Oscillograph records were made of the tapes, and all spacecraft systems that operated during the pyrotechnics events were monitored.

Phase I (performed from August 10 to 13, 1963, in Building 179, JPL) was the only portion of the test that applied to launch-vehicle integration. The electrical disconnects were fired twice; the separation pinpullers three times, and the solar-panel pinpullers twice. The procedure used was a rough draft of JPL Procedure 3R 313.00.

Measured shock responses were completely tabulated for the electrical disconnects, separation pinpullers, and solar-panel pinpullers; amplitude was quoted in peak g's, and the frequency given was the principal frequency apparent in the oscillograph playback.

A problem report was generated following the final run of Phase I. A low-resistance measurement had been noted in one of the electrical squibs in a post-firing continuity check. It was determined, however, that no problem existed. Residue shorting across the terminal leads of the squib gave the low-resistance indication.

During the pyrotechnics events, all operating spacecraft systems were monitored. No abnormal indications were noted, and the spacecraft performed satisfactorily both during and after the tests. The environmental requirements for shock tests were satisfied.

(6) Block III PTM Requalification pyrotechnics tests (post Ranger VI). Shock tests for the requalification of the Ranger Block III PTM were performed on July 11, 1964, in the pit area of Building 179, according to JPL Procedure 3R 313.06 (Ref. 32). The mechanical-separation pinpullers as well as the solar-panel pinpullers were actuated twice. No abnormal indications were noted on the spacecraft. The shock environment produced by the actuation of the pinpullers was measured at various spacecraft locations and the structural responses recorded were comparable, in magnitude and frequency, to past measurements.

The spacecraft was mated to a flight-type adapter. The electrical disconnects and the midcourse-motor pyrotechnics were not fired because the measured spacecraft responses are normally much smaller in magnitude than those of mechanical separation and solar-panel deployment, respectively. Prior to these tests, the following pyrotechnics tests had been performed on the pre-Ranger VI Block III configuration, with no abnormal indications on the spacecraft: mechanical separation, four times; electrical disconnects, three times; solar-panel deployment, seven times; midcourse-motor pyrotechnics, once. Considering the statistical variation attributable to the pyrotechnics devices, the results were as anticipated.

3. RF Interference

As part of the systems compatibility tests which were held at LMSC, Sunnyvale, from April 3 to 22, 1961, a complete series of RF tests and analyses was planned. A parasitic antenna system had been decided upon, as had been requested in TR No. 3 (TAD No. 7), which posed RF interface problems. One problem was the method by which rf transmission was to be accomplished with the mated spacecraft on the launch pad, since the spacecraft would be completely enclosed in a metal envelope during this time.

Representatives from JPL were willing to assume full responsibility for obtaining proper radio frequency authorization, but certain aspects of the test proposals were unusual enough to pose many unforeseen administrative problems. Free-running, spectrum-wide, open radiation tests such as those proposed could not be permitted within the premises of LMSC. Inter-program difficulties would have existed even though proper authorization had been obtained.

Radiations for antenna and interference-susceptibility tests, on the frequencies requested for the Ranger/Agena B/Atlas program, were authorized for Moffett Field/LMSC, Sunnyvale, on February 27, 1961. Factors considered in the authorization were the use of low powers, the confined area of transmissions, the use of directional antennas, and the short time period involved.

The Radio Frequency Interference (RFI) tests at Sunnyvale were concerned with the actual operation of the partially assembled vehicle, and with spacecraft RF radiation from both the on-board and off-board sources (Ref. 33). The off-board RF simulation provided the constant RF environment to which the vehicle was to be subjected during its normal Cape operation. The actual time of activation and deactivation of the simulation sources was called for by the LMSD Test Director in accordance with the test specification (Ref. 34). In order to preserve the frequency stability of the simulation sources,it was necessary to leave filament supplies in operation during standby periods. As an alternative, the plate power to the source could have remained on, with the source output switched into a dummy load when it was not to be used.

It was necessary, of course, that the RF simulation equipment be set up, calibrated, and in standby condition prior to each test. The calibration process required about 10 hr; during this time the test area remained free of personnel not directly involved in setting up the antennas and calibrating the RF simulation equipment. To minimize interference with other activities, this was done the night before the test began.

Placement of the simulation antennas was critical, as the antennas had to provide particular power-density requirements. Each antenna tripod was equipped with a plumb bob, and a colored spot was put on the floor to correspond to the exact position of a similarly color-coded tripod. Thus, if it became necessary to move the antennas for any reason, they could be returned to the exact spot without recalibration of power density. The focal point of all off-board simulation antennas was the lower edge of the spacecraft at the junction between sectors I and IV. Whenever the power-density requirement from some of the simulation transmitters made it necessary to place the microwave horn antennas very close to the Agena forward compartment, the beam width was restricted and all subjects could not be simultaneously irradiated. As a solution, the antennas were mechanically swept through an arc of sufficient magnitude to cover the entire compartment once every 30 sec. Fig. 33 shows the various antenna assemblies.

JPL was responsible for all RF simulation on the spacecraft; accordingly, JPL-furnished equipment was used to set the levels of launch-vehicle RF sources, and of the simulated Cape sources.

Since the constancy of the power density depended on the power "fade" of each source, cognizant operators had to maintain proper levels by source adjustment whenever necessary during the test. Frequencies were checked at the beginning and end of each day, and all changes recorded.

The order in which the various simulation sources were set up and calibrated

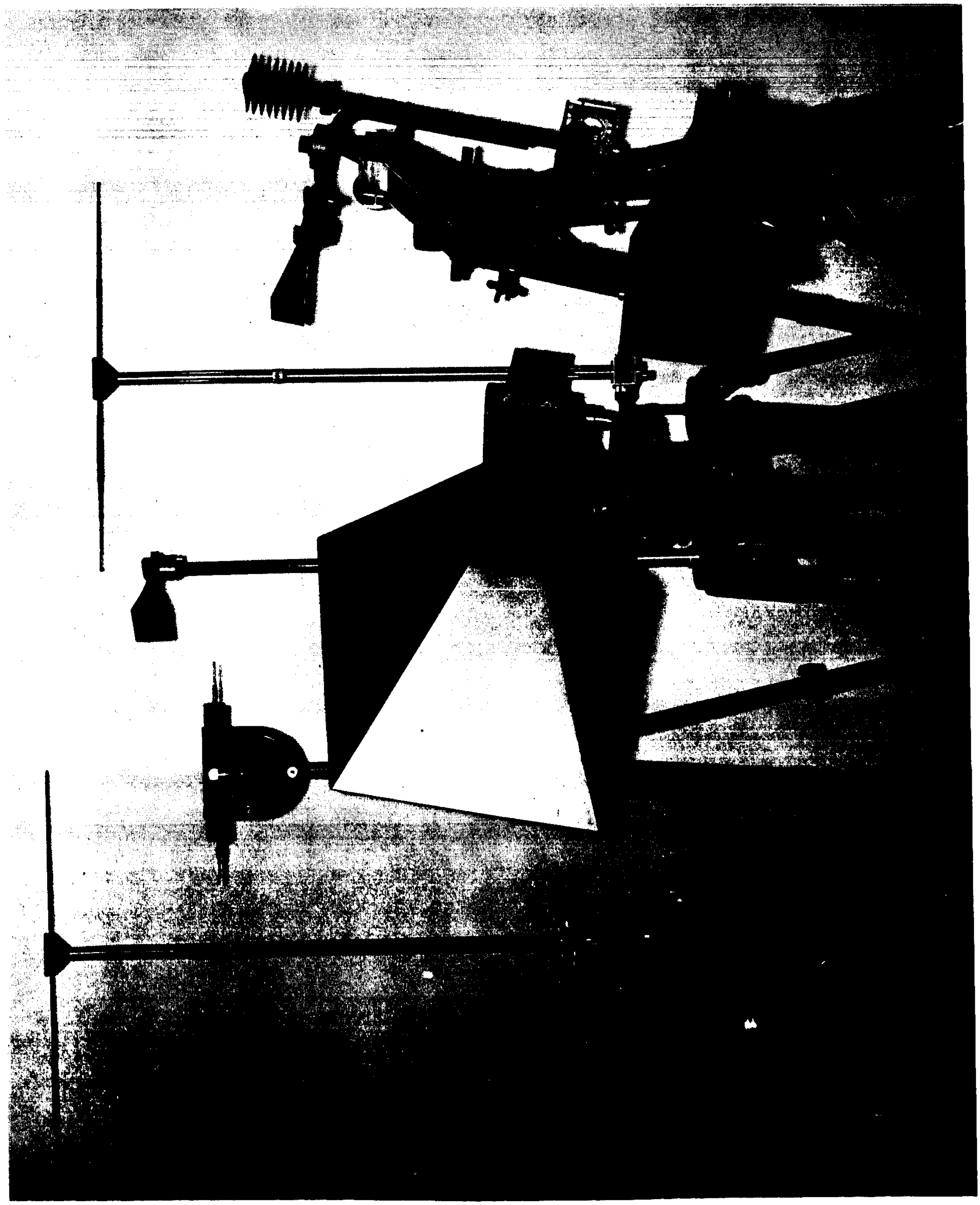


Figure 33. Antenna Assemblies for RFI Tests

was not, in itself, important. Since the power-density measuring devices were frequency-selective, it was anticipated that VHF and microwave-simulation sources could be set up and calibrated simultaneously. JPL made its setup and calibration first, however, as it had the greatest number of simulation sources. Atlas equipment, which constituted the second largest number of sources was set up next, and GE equipment was set up last, for only the booster guidance system had to be simulated.

Figure 34 shows the simulation equipment, along with power and frequency-measuring equipment.

The placement of racks and large metal assemblies was completed before antenna placement and power-density calibration began. Calibration and operation personnel had to remain out of the field of the antennas during calibration.

The operation times of the RFI simulation sources (both off-board and on-board) were specified relative to X-time. These operational sequences were called out in the "Radio Frequency Compatibility Test" (Ref. 35), and normal procedure during the test called for confirmation be made of the activation and de-activation of the RF sources to the Test Director. JPL provided RFI calibration forms for all RFI sources; these forms were filled out daily during the test period and reported any changes in power, frequency, and modulation.

JPL had the following equipment available for calibration purposes:

Hewlett Packard 430C Power Meter
Tektronic RM43 Oscilloscope
Hewlett Packard 524C Counter
Hewlett Packard 540A Transfer Oscillator
Clark Telemetry Receiver
Stoddard NM-50 Receiver
Empire Devices NF 105 Receiver
Polarad F.I.M. Receiver
Polarad TSAW Spectrum Analyzer

No insurmountable problems were evident during the tests. All events and comments were noted immediately in the JPL operations log.

RFI tests were performed subsequently on all flight-spacecraft/launch-vehicle interface equipment as part of the match-mate tests. Complete RFI tests were made on the

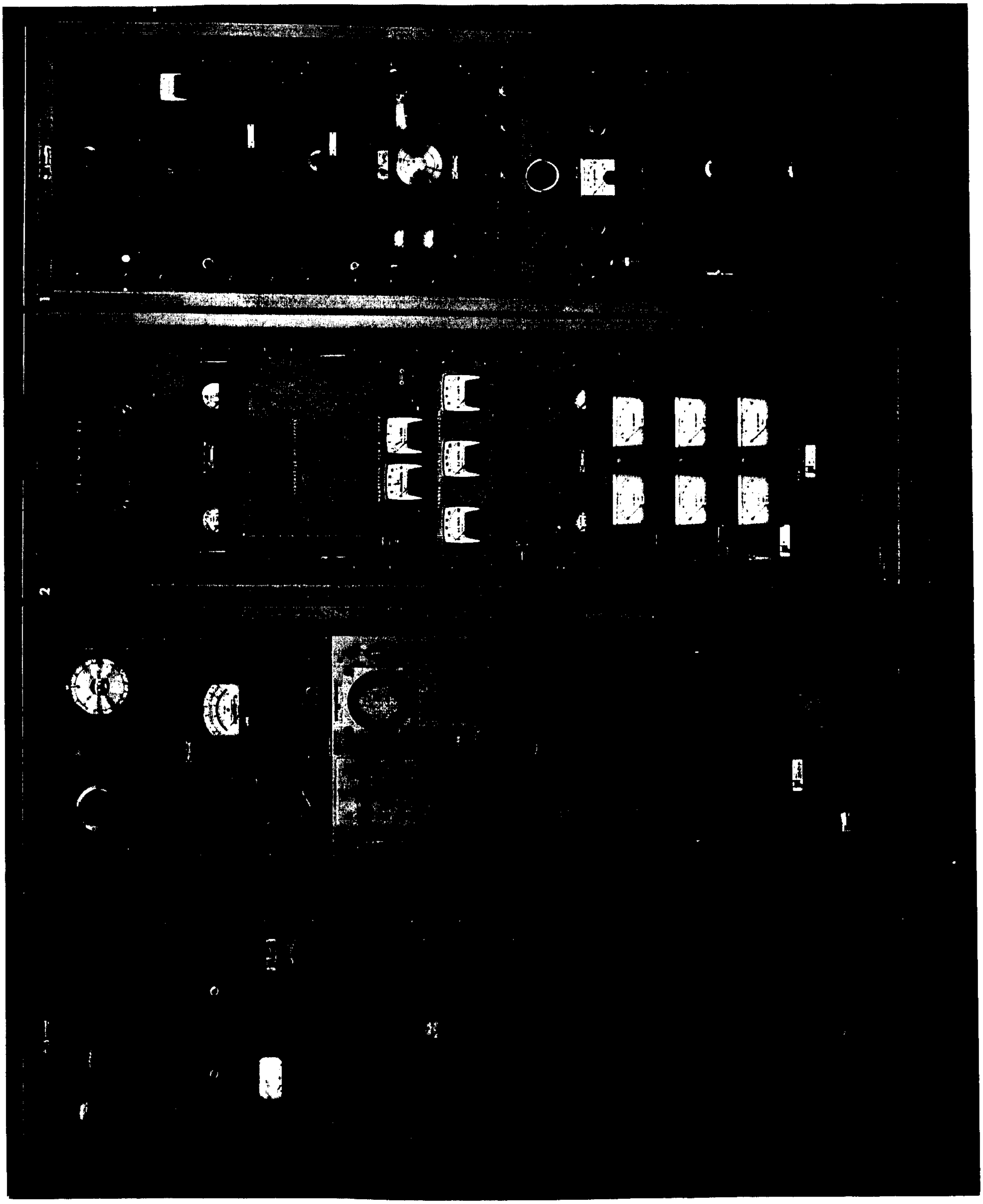


Figure 34. RF Simulation Equipment

launch pad as part of the final preparations for launching each flight.

4. Match-Mate Tests

During the program, match-mate tests were defined as the particular portions of overall compatibility tests which encompassed the physical mating of final flight hardware, the verification of electrical continuity, and the establishment of RF compatibility. Dummy runs were scheduled to make efficient use of the flight adapter and shroud while they were available at JPL.

It should be emphasized that the scheduling of match-mate tests prior to shipment of hardware to the Cape proved to be necessary for all flight hardware throughout the Ranger program. After the initial compatibility tests had been performed, the need for continued tests on flight hardware was questioned (Ref. 36); however, results showed that, in every case, unexpected problems appeared which could have caused serious delays at the launch site if they had not been detected earlier.

The interface problems between the Ranger spacecraft and the launch vehicle were compounded by several administrative factors. From the engineering viewpoint, the problems of integrating the designs were fairly obvious and straightforward. There were, however, the intangible problems of time (scheduling), distance (location of facilities), and coordination (contractors and agencies) all of which had a distinct bearing on establishing complete compatibility between the launch vehicle and the spacecraft.

Rangers I and II

Somewhat exploratory in nature, the first match-mate tests included the match-mate of Ranger I with mockup hardware at JPL on February 16 to 18, 1961 and the comprehensive series of compatibility tests at Sunnyvale on March 29 to 30, 1961 (Ref. 36). During the week of May 15, 1962, the Ranger II spacecraft was mechanically mated with the LMSD flight adapter and shroud at JPL (Ref. 37). In general, the mating was considerably smoother from an operational viewpoint than it had been on the previous occasions, but several minor discrepancies did show up in the shroud and an operational difficulty was experienced with the serrated washers.

The mating operation provided the first opportunity to go through the expected operation with the flight springs installed in the shroud. (note that all of these tests were made prior to the launch of Ranger I).

In order to install the shroud properly, it was necessary to make several minor hardware changes. This was an unexpected development in that the shroud and adapter had been assumed to be previously mated. One problem was that the shroud-to-adapter tie bolts were not properly adjusted and the pinpuller clevis would bottom before the shroud was completely down on the adapter. Another problem was encountered with the shroud pullaway electrical-disconnect mounting screws which interfered with the top of the adapter ring. Two temperature transducers were mounted on the liner of the shroud and the leads to these transducers were routed across the top of the shroud liner, thus presenting apotential hangup to the spacecraft at the time of shroud ejection. With the shroud completely installed, the clearance between the coupler and the omniantenna was 0.425 in.

At the conclusion of this test it was demonstrated that the operation was helpful in disclosing small but potentially critical difficulites associated with the interface.

Ranger III

The match-mate tests of the Ranger III spacecraft with the flight adapter and shroud were accomplished essentially according to plan. The tests were held on October 25-27, 1961, at JPL (Ref. 38).

Several difficulties were discovered during the electrical checkout tests. One such difficulty was that the shields on two different wires had defective connections. As these wires could not be completely checked after installation, it was recommended that every precaution be made to ensure good connections and continuity of all shields on future adapter cable harnesses. The cable harness on the adapter involved should have been removed, rechecked, and replaced, in order that the continuity of the shields be assured. Instead, recheck of the adapter wiring using the spacecraft simulator was made at AFETR. The same deficiency was found later on the EM 712 adapter. JPL recommended using copper instead of aluminum shielding in the adapter.

Another difficulty was that both spinoff plugs to which the spacecraft electrical cabling fastened were the same. According to Drawing No. 1317412, one should have been No. 1308962-503 (for 9AIP2), and the other No. 1308962-501 (for 9AIP1); instead, only the latter type was used. Also, the spring mechanisms for retracting the spinoff plugs at separation were not installed.

It was found that, although the four RF pins in the umbilical receptacle should have been removed for installation of the ground half of the umbilical plug, this had not been done. (This had been agreed to before the Ranger I flight, but documentation to show the fact that they were still in the receptacle indicated that there had been no official documentation concerning this requirement).

The structural mating of the spacecraft to the adapter was done in accordance with LMSC's procedure No. OP-AMR-132 979A, and no difficulties were encountered. The procedures for installing the shroud were checked and revised in accordance with improved methods which had been developed to locate, and accurately check the location of, the omniantenna coupler. Because the final flight items of the retromotor and the ADF capsule were not installed until a few days prior to flight, the operation of checking the location of the coupler in relation to the antenna spike had to be repeated at AFETR.

When the shroud was installed, it was discovered for the first time that the flex cable leading to the Earth sensor interfered with the shroud. The shroud was raised and the cable tied back to prevent damage. The problem was resolved prior to sending the spacecraft to AFETR. RF measurements on the omniantenna and coupler system indicated the VSWR and attenuation were within operational limits. Measurements on the high-gain antenna system were inconclusive because the Agena forward-equipment rack was not available. These measurements had to be made at AFETR.

Ranger IV

The Ranger IV match-mate tests were only partially accomplished at JPL during the period January 3 to 5, 1962 (Ref. 39). The tests were limited in scope since only the flight adapter was available and since the flight shroud was delayed because of the installation of the angle-of-attack instrumentation.

The following portions of the original schedule were performed with satisfactory results: the electrical harness pin-to-pin checkout connection of spinoff plugs and umbilical connector, and physical mating of the spacecraft to the adapter.

A spacecraft functional checkout and release, and a simulated squib-firing test replaced the RF portion of the test, which was not performed.

Ranger V

Match-mate tests using the Ranger V spacecraft and the LMSC No. 6005 adapter and shroud were accomplished at JPL from July 13 to 15, 1962 (Ref. 40). The minor difficulties encountered are indicated below:

a. Simulator checks through the adapter were not made because of inadequate cabling (a JPL responsibility).

b. The previous inspection of the in-plane condition of the adapter spacecraft mounting points was considered to be inadequate. The inspection was repeated at JPL, and the proper shim thicknesses were used for mounting the spacecraft.

c. There was only marginal clearance between the shroud and the case of the high-gain antenna actuating gear box, however, it was not of sufficient importance to stop the tests.

d. Antenna bumpers on the adapter were the Mariner Venus type with aluminum, not rubber, heads. Since the rubber-covered antenna bumpers (LMSC Drawing 1314326) had been qualified for the Ranger spacecraft and the bare metal ones had not, it was necessary to change to the rubber-headed bumpers.

e. The RF tests were completed with no difficulties, however, it was later found that the check of high-gain antenna operation was made with the probe located in the position for Mariner Venus. This portion of the test had to be rerun prior to shipment to AFETR.

Ranger Block III Match-Mate Tests

Previous to Ranger VI, the adapter had been shipped in a wooden box, with no attempt to hold rigid either the mounting ring which fastened to the Agena or the six mounting points to which the spacecraft was attached. As a result, the relaxing of internal stresses could warp or change the shape of light adapter structure during shipping and handling. Measurements made prior to actual final mating at AFETR were therefore of questionable accuracy. It was agreed that JPL would furnish LMSC a rigid ring, mounted on a dolly on which the adapter could be mounted, and bolted down prior to shipment to JPL for the match-mate tests.

The adapter would remain attached to the ring until final installation on the Agena before flight, and measurements of the spacecraft mounting points could then be depended upon to remain essentially constant. LMSC agreed to make the measurements at their plant in Sunnyvale, thus reducing the amount of time needed at JPL for the match-mate tests.

Ranger VI

From September 4 to 7, 1963, the match-mate tests using the Ranger VI spacecraft, adapter serial No. 6008 and shroud serial number 6008 were performed at JPL. A list of action items developed from these tests follows.

a. The shield return on 9W110 P2 Pin A was not connected to Pin 1F on the umbilical receptacle, and it was found that Drawing No. 1342539 was incorrect. Both the drawing and the Ranger VI hardware were corrected prior to shipment to AMR.
b. Solar-panel and shroud clearance was only 0.020 in. An investigation was made, but no action was necessary.
c. The locations of the linear pots which indicate spacecraft separation were off-center of the striker plates on the spacecraft. JPL and LMSC investigated and found that one linear pot was installed incorrectly; this was corrected. The others were satisfactory as installed.
d. LMSC was to update their Specification No. 1415559 A.
e. The clearance between the TV micro switch and its pad was to be specified in LMSC Specification 1415559.
f. Springs to pull back the twist-off fittings were missing. LMSC installed the springs on Ranger VI hardware prior to shipment to AFETR, but new instructions were to install springs on future hardware prior to match-mate tests.
g. The electrical cabling to the spinoff fittings was approximately 6 in. too long. LMSC investigated and shortened the cables prior to shipment to AFETR.
h. LMSC was to furnish JPL with the shroud-microphone installation prints.
i. LMSC was to include a dust cover for the bottom of the adapter; for Ranger VI at AFETR, for Ranger VII, and for subsequent match-mate tests.
j. Investigations of the clearance of the pinpuller-monitor switch bracket and of the rotary-coax housing-clamp bolt head were made. It was deemed satisfactory for Ranger VI, but the bracket was redesigned for Ranger VII and subsequent spacecraft to give greater clearance.
k. RF losses between the omniantenna and the shroud coupler were 2 dbm greater than expected; however, these losses were acceptable.

Ranger VII

Match-mate tests of the Ranger VII spacecraft, adapter 6009, and shroud 6009 were performed at JPL from October 15 to 21, 1963 (Ref. 42). Action items developed from these tests were as follows:

a. Shim heights determined from the spring-constant tests for the spacecraft/adapter combination were determined to be:

Foot B	0.013 in.
Foot D	0.013 in.
Foot F	0.015 in.

These values were consistent with shim thicknesses determined on previously tested spacecraft and adapters. JPL was therefore asked to investigate the possibility of eliminating the spring-constant portion of the match-mate tests for the future and to use a standard shim thickness at all spacecraft feet. Although the investigation was made, it was decided that, since there were only two more Ranger spacecraft to be tested, it would be wise to continue the spring-constant portion of the tests to ensure that the proper shims were used. Results of this decision are discussed in the section on Ranger VIII match-mate tests.

b. The bracket for the backup timer switch at Foot F was to be fabricated with enlarged mounting holes so that a higher degree of adjustment in matching it to the timer position would be possible. This was accomplished by LMSC and was one of the signoff items on the DD-250 acceptance of the hardware.

c. LMSC was to change their match-mate procedure No. 1415559B to provide for adjustments of the pads on the adapter to fit the timer and switch on the spacecraft. The C change was made, and it was incorporated on November 5, 1963.

d. More clearance was required between the TV switch pad near Foot E and the high-gain antenna. The switch pad should have had 1/8 in. cutoff to provide the necessary clearance. LMSC accepted and accomplished this action item.

e. The solar-panel hinges on the Ranger VII spacecraft had been reworked, approximately .030 in. and had been cut off and the points which showed interference on Ranger VI were smoothed. These points cleared the shroud inner liner on Ranger VII, but two other points about 1 in. above these (3/4 in. forward of Sta. 500) did indicate a slight interference, as a piece of paper approximately .003-in. thick would not slide freely between the points and the liner. It was noted that the nose-cone liner stood away from the nose-cone base structural ring by about 1/8 in. at these points. LMSC corrected this condition in such a manner as to preserve the "skid-ramp" effect of the liner over the base ring, i.e., the liner still protected the base ring from direct exposure to the spacecraft during spacecraft separation.

f. Holes had not been drilled in the cover over the noise microphone in the shroud to allow the sound to impinge directly on the microphone. LMSC corrected this condition by removing the cover.

g. An accelerometer and amplifier assembly near Foot C was not in its place. The assembly was correctly installed prior to flight.

h. The RF portion of the match-mate tests was conducted in accordance with JPL Procedure 3R 405.00. Results of the tests were satisfactory. The correlation between the calculated loss and actual power measurements was good and the 2.2-db discrepancy between the loss and actual power measurements, as found on the Ranger VI omniantenna path, was not encountered on Ranger VII.

The Ranger VII spacecraft dummy run was made on October 18 and 19, 1963, using the flight adapter and shroud. On October 21, the LMSC hardware was packed and loaded by JPL technicians under supervision of LMSC personnel for return to Sunnyvale.

Upon return of the shroud and adapter it was noted that the adapter inside surface was dirty with what appeared to be an oily carbon film. It was recommended that JPL review their spacecraft pyrotechnics (solar-panel release squibs) as a possible source of this contamination. Investigations indicated that there was little or no possibility that the contamination came from this source; however, JPL agreed to take special precautions with the next match-mate test and to determine, if possible, whether any contamination would result from firing of the solar-panel pinpullers (Ref. 43).

Ranger VIII

Two match-mate tests of the Ranger VIII spacecraft, with adapter and shroud No. 6006, were performed at JPL, the first on February 11 to 14, 1964 (Ref. 44), and the second on October 29 to November 5, (Ref. 45).

First Match-Mate Test

The spring-rate constants for the combined Ranger VIII spacecraft and 6006 adapter were significantly different from those previously tested. This was left open, subject to further investigation. JPL later performed additional tests on the spacecraft and found no real difference in its spring rate from those previously tested. Recommendations were then made to return the adapter No. 6006 to JPL for further tests and investigation. This was done on April 20 to 22, 1964 (Ref. 46).

Before the tests started, it was suspected that the irregular performance of adapter 6006 was caused by the lack of certain screws which fasten the nonflight structural doors to the internal structure of the adapter. These screws had been installed in all previous adapters on which tests were run, but were omitted from the nonflight doors on adapter No. 6006 to shorten manufacturing procedures. The manufacturer was certain that the nonflight doors would be satisfactory to hold the adapter in shape without the screws, but he did not anticipate irregular spring rates during integration tests. To confirm this supposition, spring-constant tests were run, first with the adapter in the original condition to prove conformance and validity of the original tests, and second, after approximately 85 screws had been added.

Test results indicated that: (1) the combined spring-rate constants before installation of the screws were essentially the same as they were during the original match-mate tests in February; (2) the combined spring-rate constants, after the installation of approximately 85 screws attaching the nonflight structural doors to the internal structure of the adapter, were essentially equivalent to spring-rate constants made on spacecraft/adapter combinations prior to the Ranger VIII match-mate tests.

Special inspection procedures were carried out to ensure that there would be no contamination of the adapter due to the firing of solar-panel pinpuller squibs during the JPL dummy run:

a. Six polished aluminum sheets each approximately 1 ft square, were placed at the center of each spacecraft bay, near the top of the adapter, to catch any possible contaminants. The aluminum sheets were numbered for identification purposes. Concurrence in the placement of the sheets was obtained from representatives of both LeRC and LMSC.

b. A mylar sheet was placed between the spacecraft and the adapter to protect the adapter from any possible contamination.

c. Photographs were made of the polished aluminum plates both before and after squib firing. The results of both visual and chemical analyses showed that there was no contamination other than that incurred in normal careful handling on either the aluminum plates or the mylar sheet.

d. It was agreed that the aluminum plates could be omitted in future dummy runs in which the flight adapter would be involved, and that efforts to avoid contamination of all flight equipment should be continued.

Other minor faults were recorded in the inspection,and routing action was taken to correct them.

Second Match-Mate Test

Since a delay in flight schedules caused a considerable time lapse between the first match-mate test and the final flight date, a second match-mate test of Ranger VIII hardware was required. In this period numerous changes were made to both the spacecraft and the adapter and shroud hardware.

JPL Procedure 3R 405.03 was used in the completion of the RF loss measurements. These measurements were performed with the spacecraft mounted on the LMSC flight adapter and the mockup of the Agena forward-equipment rack; the flight shroud was installed. All losses appeared to be normal and compared favorably with loss data from previous spacecraft.

The RF losses which were actually measured on Ranger VIII were:

Losses db	Ranger VIII	Ranger VII (Ref.)	Ranger VI (Ref.)
Omni 890 Mc	5.26	5.54	4.3
Omni 960 Mc	11.77	11.62	12.8
H. G. 960 Mc	10.06	9.10	8.5

At the beginning of the RF tests, it was apparent that there was no continuity from the spacecraft radiating antenna through the antenna coupler and coax cable in the nose fairing to the external test instruments. After considerable delay, the nose fairing was disconnected and removed. It was found that the coaxial cable was disconnected from the coupler even though several inspectors had indicated, with signatures, that it was connected. It was recommended that the final inspection procedures be tightened.

In measuring the spring constants, there was no indication of the sponginess that had been exhibited in the previous match-mate tests of Ranger VIII. The shim values required to obtain the desired 200-lb preload were: Leg B: 0.016 in.; Leg D: 0.016 in.; and Leg F: 0.017 in.

The umbilical door on the adapter had too great a gap. LMSC, under cognizance of LeRC, determined what action to take, and fixed the discrepancy prior to DD-250 acceptance.

The threads of the high-gain antenna snubber at Foot D were galled. LMSC corrected this condition prior to DD-250 acceptance.

An amplifier for the spacecraft vibrometer had been installed in the adapter and grounded to the frame.

The striker pad for the hydraulic timer at Foot F was tilted out of the horizontal plane by approximately 0.035 in. from one side to the other. This was not considered to be a serious problem.

Clearances between the solar-panel hinges and the shroud did not require rework. The clearance at Leg D was 0.050 to 0.060 in., and clearances at Legs A, B, and E were 0.100 in. or greater.

The clearance between the rotary coax and the fiberglass at Foot C was 0.115 in.; this was considered satisfactory. For Ranger VII, the clearance was approximately 0.095 in.

Ranger IX

Match-mate tests of the Ranger IX spacecraft with adapter and shroud No. 6007 were performed at JPL from December 21, 1964 through January 4, 1965 (Ref. 47).

The adapter electrical checkout and the operation of the adapter umbilical door were satisfactory. Since the high-speed motion pictures taken at liftoff showed that the door did not latch, an additional spring was to be added to the door; however, this was never accomplished.

No trouble was encountered in determining the Ranger IX spring constants. The shim values (in inches) required to obtain the 200-lb preload were:

Leg B	0.017
Leg D	0.017
Leg F	0.016

The test sequence for measuring the clearances between the shroud liner and the hinge points on the solar panels had to be performed twice. Since the spare set of solar panels had been machined differently at the hinge points, it was necessary to perform separate tests of both the flight and the spare panels, with each set of panels mounted on the spacecraft.

Clearances at Ranger IX solar-panel hinge points, measured in inches, are as follows:

Leg:	Flight Panels	Spare Panels
A	0.33	0.23
B	0.27	0.26
D	0.25	0.23
E	0.30	0.18

The first TV-camera test involving the TV test lights in the shroud showed intermittent operation. The problem was corrected by having the small bolts on the shroud light connector tightened.

One of the TV test lights was not clearly defined during the camera test. Upon investigation, it was determined that the image could be improved considerably by enlarging the hole for this particular light in the shroud liner. However, the JPL test conductor preferred to accept the TV test lights in their "as is" condition rather than to remove a portion of the shroud liner and become involved in the accompanying hazards of reinstallation. LMSC did enlarge the hole without removing the liner from the shroud. It was satisfactory upon arrival at AFETR.

The shipment date of LMSC flight equipment back to Sunnyvale was delayed until January 4, 1965, because the validity of measurements of the RF losses through the shroud was questioned. The problem was noticed during countdown tests (held after the match-mate tests) when RF losses through the spacecraft omniantenna, shroud coupler, and cabling did not appear to be repeatable. The difference of 1-1/2 db between the actual telemetered readings and the calculated readings was due to the shroud measurements.

After repeated tests, it was determined that the shroud measurements were correct; however, the dummy-run tests extended beyond the previously estimated date of completion.

5. Ranger VI Post-Flight Tests

On March 23, 1964, the Ranger Project Office asked the Launch Vehicle Section to consolidate and coordinate the investigation activities, with a view toward answering questions which had arisen subsequent to the Ranger VI flight.

These investigations were intended to do, in general, two things: to determine whether the launch-to-injection environment could possibly have affected the operation of Ranger VI TV circuits; and to ascertain that future changes introduced on the Ranger VII spacecraft would preclude any deleterious effects caused by this environment.

The specific purposes of the investigations were: to identify areas in the launch-to-injection phase of flight which were believed to be problem areas; and to establish a general test plan to prove or disprove the existence of problems within these areas.

Initial meetings were designed to identify problem areas, coordinate the efforts of the persons and organizations involved, and define responsibilities for each area of investigation. Formal conferences were convened on March 31, and April 1, 1964, for these purposes.

It was decided that two classes of problems should be established, one of which would include problems of determining any unknown condition in the launch-to-injection environment, and the other of defining any unknown susceptibility of the spacecraft and launch-vehicle subsystems.

The general environmental problems were:

a. To determine the extent of charge-or degree of voltage-buildup on the launch vehicle in relation to time and discharge characteristics of the static charge.

b. To determine the characteristics of ionized gases combined with an electrostatic charge on the surface of the launch vehicle.

Susceptibility problems were:

a. To determine the susceptibility of the spacecraft and launch vehicle to electrical transients, static charges, and electrical discharges.

b. To determine the preventative measures which had been taken in the launch vehicle against static discharges.

c. To verify the integrity of the launch-vehicle and spacecraft grounding systems.

Independent activities at JPL were already underway at this time. Tests had been conducted on a connector and a switch in a bell-jar at RCA, and the results had been reported to JPL; further tests were to continue at RCA. A request had been made to investigate RF transients during the flight of the spacecraft. A study of the charge effects from the viewpoint of upper-atmosphere physics and from the viewpoint of susceptibility of the spacecraft-to-RF switching and coupling transients was underway. All these efforts, however, had been limited to telemetry up to this time. The value of a series of tests using a high-voltage generator on an adapter/shroud/spacecraft combination in a space chamber was investigated.

During the course of the investigations, a meeting was held at the Space Technology Laboratory (STL) on April 21, 1964, concerning the electrical charge and discharge problem. The general purpose of this meeting was to review details of certain launch-vehicle electrostatic discharge problems which had appeared in one of the Air Force programs. The specific purpose was to ascertain what tests had been made, how they had been made, and what conclusions had been established upon completion of the tests.

STL's experience in this program had been brought about because of repeated failures in one of the missile systems with which they were concerned. An important aspect of the system was that the payload was in a unique configuration, that is, the payload together with the nose fairing, was insulated from the main body of the launch vehicle. STL uncovered transient susceptibilites in some key components, and this led them to perform a series of tests to determine the extent of susceptible circuits in the system. Corrections in the design were made by the use of proper grounding techniques.

In the meantime, STL investigated the possibility of transients occurring in their system because of arcing phenomena. Some preliminary tests were performed, and it was demonstrated that there was, in fact, arcing between the main body of the launch vehicle and the nose fairing; it was also demonstrated that the arcing was the source of transients which were transmitted through the grounding system. Several types of tests were performed to isolate the problem, with the preliminary ones performed by North American Autonetics in a three-month period.

One series of tests consisted of applying signals to shields to determine the interference susceptibility of sensitive circuits; another consisted of putting charges on different portions of the launch vehicle to determine arcing characteristics. Results of the testing showed that some components were susceptible to transients and that arcing took place when the nose fairing was charged to 30, 000 v. It was determined that the transients which result from arcing can cause catastrophic secondary effects, even though the damage caused by the arcing itself may be negligible.

a. Charging mechanism in the environment. Various ways in which the launch vehicle is subjected to charging mechanisms in flight were reviewed. The following is a summary of these charging mechanisms.

(1) Rocket exhaust. An important mechanism which produces a charge on a rocket or on a launch vehicle is the rocket exhaust. The particles produced by the propellants during the burning and exhaust processes produce a net charge on the entire vehicle, at a charging rate which is constant throughout most of the burning time. Electrical fields of 100,000 v/m on the launch vehicle, caused by the exhaust charging action, seem to be possible. Charging rates had been determined for various small engines, and these rates had been extrapolated to obtain rates for large engines. The charging rates , in microamps, were:

Small rocket (Boeing), 20
Small rocket (Stanford Research Institute), 30
Large rocket (extrapolated), 200

An order-of-magnitude difference of 2 was shown to exist between the ionizing effects of solid and liquid propellants.

Solid Propellant:	On the order of 10^{12} electrons/ cm^3
Liquid Propellant:	On the order of 10^{10} electrons/cm^3

The conductivity of exhaust gases at the exit plane was determined to be about 25×10^6 esu. This is about 1/10 the conductivity of dry earth and about 1/1000 the conductivity of sea water.

(2) Ionization in the atmosphere. Large electric fields in clouds may give corona discharges to a launch vehicle which passes through them. These have the effect of actually charging mechanisms on the rocket.

(3) Natural inductive charging. Due to its radioactivity, the Earth is considered to be a positively charged body which is surrounded by changing local fields. The charge on the Earth is about 300 vm, although the net charge of the Earth system with its fields, eventually becomes zero as a rocket leaves them completely. Under certain circumstances, effects of this charge although they are small, should be considered.

b. Susceptibility. In analyzing the succeptibility of circuits, it was shown that structures and components which are isolated have a value of capacitance that is important in determining arcing characteristics. This applied to individual spare wires in a cable if they are not grounded at either end.

Even in a spherical shell with perfect conductivity, enormous signals could be generated for a very short period of time if the shell were to be separated suddenly into two halves. There would be no change in potential, but a very rapid redistribution of charge on each portion would occur, that is, $\frac{di}{dt}$ would be very high for a very short period of time. These current transients could be transmitted through the structures or through ground lines. Another factor would be that large electric field strengths may appear at sharp points, at corners, and at pins.

STL test results indicated that the following steps could be used in a procedure to determine the possibility of Ranger malfunctions due to static charge buildup.

(1) Transient tests. Inject high-frequency signals into ground lines with frequencies ranging from 50 cps to 5 Mc. Critical frequencies are expected to lie between 1 and 5 Mc.

(2) Static charge buildup. Couple a Van de Graaff (or high-voltage) generator between ground and a point on the launch vehicle and build up a static charge. Operate the equipment under various charge environments during the period between 100 and 250 sec after launch. Payload equipment must operate on its own power, and monitoring equipment is expected to determine deviations of payload operation from normal operation.

(3) Deshrouding. Under various static charge conditions on the launch vehicle and while the payload is operating, remove the shroud at the same time as it is ejected in flight.

(4) Static discharge. Couple a Van de Graaff generator between ground and the tip of the nose fairing. Under various charge conditions.and while the payload is operating, short out the static charge from the fairing to ground.

Although STL was able to define their particular problem and to take corrective action, it did not seem that the same problem existed on Ranger; nevertheless, it was recommended that the above tests be performed to determine whether or not electrostatic charge buildup could, in fact, cause spacecraft malfunctions.

A preliminary plan for conducting static discharge tests was proposed on April 9, 1964. The general purpose of this plan was to determine the possibility of an arc discharge between various parts of the spacecraft, caused by static charge buildup in the launch phase. One specific purpose was to determine the voltage difference between the spacecraft structure and the circuitry which was isolated by the DC bus-return resistor. The proposed plan encompassed the following three phases.

Phase I

Laboratory tests to determine the validity of the premise of a voltage gradient

Laboratory tests to determine whether or not the anticipated voltage gradient was approximately correct

Phase II

Tests on subsystems

Phase III

Ambient atmosphere tests on spacecraft with arc-over control

Complete spacecraft tests in vacuum with no arc-over protection

Phase I tests were to be made in the EMI laboratories to determine whether the anticipated effect of uneven charge buildup between the isolated circuitry and structure of the spacecraft existed, and to determine the order of magnitude of the effect. Simplified models were to be used.

Phase II tests were to be performed on some selected subsystems to determine if the voltage gradient represented a problem. This test would require a vacuum chamber large enough to house the subsystem. A rough-approximation pressure profile of launch was to be performed while the anticipated voltage gradient was being impressed upon the test sample.

Phase III tests were to involve a complete spacecraft and were to be conducted in conjunction with tests on static charge buildup. It was planned that the initial test would be run at one (1) atmospheric pressure, and that a voltage-limiting device would be installed to prevent arc-over between portions of the spacecraft. The final test of this phase and of the test program was to be performed on a complete spacecraft in vacuum. The pressure profile of launch would have to be performed while the static generator was functioning. Any arc-over would be cause to stop the test, return to 1, and determine the location of the arc.

An alternate Phase III test could be performed, if the voltage gradient could first be determined with reasonable accuracy, by impressing a generator representing only the known voltage gradient between the structure and the isolated circuitry. The necessity for a high-voltage generator and the associated precautionary measures would then be precluded. The results of Phases I and II would determine the feasibility of such an alternate procedure.

Second test plan. It became apparent that the first test plan was too ambitious and encompassed too many details to provide the required information in the time available. A second test plan and tentative schedule for Ranger high-voltage tests was proposed on April 29, 1964. One objective of the abbreviated tests was to determine the values of isolation resistance and the capacitance of wires, circuitry, and subsystem boxes so as to predict possible voltage differentials which would exist during high voltage tests. Other test objectives were to determine whether or not a sufficient voltage differential could exist between shroud and circuitry to cause malfunction, arc-over, or activation of TV command switch, and to determine the charging rates necessary to cause detrimental effects.

Upon completion of these tests, a conference was called June 3, 1964, to determine precisely the status of all current and proposed tests and to summarize the preliminary conclusions relative to the completed tests. This was quite necessary in view of two facts, i.e., that the Ranger VII spacecraft was to be shipped to AFETR in about two weeks, and that the test data so far obtained was to be evaluated completely and in detail prior to shipment.

Activities in six different areas of investigation were reviewed briefly. A short summary was presented in each of these areas concerning the results which had so far been obtained, and tentative plans were made for further tests in some areas. The summaries follow.

Mechanical tests. The results of the mechanical tests performed on the Agena adapter umbilical door were reviewed and analyzed. A preliminary examination of the pictures showed that there was bending (warping) of the door outward even though the door was latched. It was suggested that if the door bent outward, it would be possible for the latch to move inward, possible shorting the pins on the connector.

A proposal was made that the umbilical door and latch be isolated from the umbilical pins by means of insulating paints or sprays. In future flights the idea of disconnecting the umbilical connector internally at launch was advanced.

Mechanical tests, which involved hitting the closed umbilical door with a rubber hammer to determine whether the latch could possibly short to the pins, were performed and were completed prior to Ranger VII shipment.

Shock-wave theory. Investigation was initiated concerning a theory that a shock wave is produced at booster staging when the excess LOX is dumped into the atmosphere. Calculations were made within the Aeronautics Department at CIT to determine the characteristics of the ionized gas and possible shock wave at the umbilical door.

Moving pictures of the Atlas staging in flight showed a luminous front moving upward past the spacecraft. It was suggested that the energy of the wave may have produced a mechanical effect, and that ionized gases in the vicinity of the umbilical door may have caused a low-impedance path between pins in the connector.

Ionized gas and electrical transients. Tests were performed to determine the impedance between pins under a controlled environment of varying known conductances. Also, an investigation was made of possible electrical transients originating in the Atlas and traveling upward to the TV package. Preliminary results showed no apparent problems in this area. There were no hard-line connections between the Atlas and the spacecraft (only five relays), and there was one signal connection at the

Agena/spacecraft interface, the latter, however, was isolated by transformers at each end.

A second meeting was held on June 12, 1964, to discuss results and plans concerning the high-voltage and RCA tests. These tests, which had been performed simultaneously, were completed on May 28, 1964. The meeting included a technical discussion of test results, an evaluation of the test philosophy, and the formation of new plans.

High-voltage tests. Various circuits in the spacecraft were monitored and 200-mv transients were observed in nearly all of them. The instrument readings were not as accurate as was desired, due in part to the extremely short arc-discharge time and to limitations in test-equipment selection.

It was emphasized that the high-voltage tests had been implicitly performed in the nature of the experimentation, since there was little information available concerning the electrostatic flight environment to which the spacecraft would be subjected. Basically, the tests were attempts to perform a first-order analysis on a small geometrical spacecraft/launch-system model. With the use of a 600 kv high-voltage (ramp-function) generator, tests were performed by building up a static charge on the launch system and discharging it to ground. Purposes of the tests were to determine:

(1) Breakdown of components caused indirectly by discharge of a static charge from the launch system.

(2) Malfunctions and improper operation caused indirectly by discharge of a static charge from the launch system.

From the results of the tests, it could not be determined whether a problem existed or not. There appeared to be none in the charging portion of the cycle, but the command switch on the TV package was found to be in a stepped position on two separate occasions. Whether or not stepping was caused by arc discharge was not known.

Representatives from the Guidance and Control, Telecommunications, and Propulsion Divisions contributed greatly to the technical discussions, making it possible to define problems in the over-all investigation when previously there had been only a search for general problem areas.

RCA tests. The following RCA tests were performed simultaneously with the experimental high-voltage tests on the spacecraft by RCA and JPL personnel.

Series	
1	Ranger VI command switch grounded
2	Ranger VI command switch isolated
3	Ranger VII Configuration

Results of the tests were considered to be inconclusive. The actual test results were opposite from the expected results, in that oscilloscope indications were of reversed polarity.

Tne command switch was stepped once indirectly during tests which discharged a static charge of 120 kv to ground. Since this did not reoccur for the balance of the tests (under various test equipment and configurations), a possibility existed that a momentary short in the test equipment might have caused stepping of the switch, but this was by no means a certainty.

Information concerning the frequency characteristics of the discharge arc was obtained by connecting an oscilloscope to the ground strap on the discharge probe. The fundamental frequency of the arcs generated during the tests may have prevented a true picture of the actual-flight discharge frequencies, since the test configuration was only one-fifth of the length of the complete Atlas/Agena/spacecraft assembly. This indicated a need for interference tests.

A new series of tests, proposed by RCA, consisted of two types of tests on the Ranger VII TV package alone (Ranger VII configuration), and three types of tests using the Ranger VII TV package installed on the spacecraft bus.

The proposed RCA tests were:

a. Determine noise-susceptibility characteristics of the silicon-control rectifier (SCR) in the TV turn-on circuit configuration (TV package only).
b. Perform a series of tests on the TV package as follows:
   (1) Discharge a test capacitor in the vicinity of the command line using 10 microfarads at 100 v.
   (2) Run a line close to the command line and couple capacitive discharges to it.
   (3) Pump transients at various frequencies through a capacitor and into the end of the command line.
c. Perform tests on the TV package and spacecraft busy by passing current over the bus skin (without shroud)
d. Establish arc discharges in the vicinity of the spacecraft
e. Discharge low-voltage charges into the skin of the spacecraft/TV assembly

Specific questions which remained to be answered were:

Why were test results opposite from those which were expected theoretically?

What is the charging rate on the launch system?

What is the highest charge developed in flight?

What is the polarity of the static charge?

What is the mechanism for causing arc discharge?

Does corona discharge appear at the pins in the umbilical connector?

What is the resonant frequency (ringing frequency) of the command switch circuit?

What is the fundamental frequency of the arcing current (discharge)?

It was shown that the test model may not have been realistic for the following reasons:

(1) The length of the model was not correct; this may have affected the frequencies in the discharge currents.

(2) Vibration, partial pressure, and ionized gas were not present for the simulation of these tests.

In view of the discrepancies which had been brought out, it was decided to reassemble the TCM and launch-system test configuration as soon as possible and to proceed with a new series of tests. The purpose of the new tests would be to determine the answers to the specific questions, and, hopefully, to resolve the discrepancies between the theoretical and actual results in the first tests. It was suggested that additional techniques should be used, such as a dummy loop for checking electromagnetic coupling and calibration of the scope amplitude after each test. The responsibility of the Launch Vehicle Section for conducting these tests was terminated at this point, and any further testing was to be under the cognizance of the Environmental Requirements Section.

B. SPECIAL TESTS

1. Agena Hot-Firing Tests

An Agena and a dynamic mockup of the Ranger I spacecraft were used in the static hot-firing tests conducted at Lockheed's Test Basin in Santa Cruz on May 3, 1961 (Ref. 48). The tests consisted of a 150-sec firing followed by shutdown, restart, and a 100-sec firing.

Acceleration measurements taken on the spacecraft indicated that the maximum power spectral densities (PSD) induced by the firing, in the case of the bus feet and the solar panels, exceeded the limits set for JPL flight acceptance by the Type Approval specification. The wideband (15-1500 cps) rms vibration level of all locations except the solar panels was below the wideband rms level of the noise-burst portion of the applicable flight-acceptance specifications.

The Agena vehicle was mounted in a test stand which was closed on four sides and at the top by corrugated metal siding, and open only at the bottom, above the flame deflector. Enclosed use of the stand undoubtedly caused sound pressure levels at the forward end of the vehicle to be higher than those that would accur in an unenclosed stand. The vibration isolation frequency of the vehicle's support structure was reported by LMSC to be below 15 cps.

The dynamic mockup of the Ranger I spacecraft configuration was the same as that used in the LMSC compatibility test and was similar to the one employed in JPL composite structural tests. The Agena vehicle, adapter, and shroud were flight equipment (Serial #6001).

Two microphones were used to determine the sound pressure level during firing; they were placed opposite each other slightly above the base of the shroud (one just inside the shroud, and one about two feet outside).

<u>Test Data</u>

Data from the external microphone were lost because of a recording malfunction. The frequency spectrum of a similarly located external noise measurement on a different Agena was investigated, but there could be no direct substitution, of course, for the lost data.

The sound pressure level of the internal microphone was plotted along with the external noise spectrum supplied by LMSC. Assuming that the LMSC data was strictly applicable to this hot test, it can be said that no attenuation was provided by the spacecraft shroud. Within the accuracy of the data reduction, the spectra exhibited the same shape and the same overall (15 - 1500 cps) sound pressure level of 134 db.

Data from the internal microphone indicated an initial pulse of at least 0.11-psi overpressure during the first ignition; the data were out of band at this point. A recording malfunction obscured the presence of this pulse at the start of the second firing. The overpressure pulse produced a 3-g rms ringout of the solar panels at their first natural frequency, 58 cps. This ringout decayed within about 10 cps and was replaced by random oscillation.

Only the first 70 sec of the microphone data on the first firing were available for analysis; the remainder of the first firing and the entirety of the second firing were out of band. This was caused by an instrumentation malfunction, i.e., a very low frequency (0.3 cps) oscillation of the carrier, beginning 70 sec after ignition.

Since it would be fired only in space, the Agena, as the second stage of the Ranger vehicle, would not, in flight produce acoustical excitation of the spacecraft. The value of the acoustic measurements lay chiefly in the possible correlation between spacecraft vibration levels and both the external sound pressure level (given by LMSC) and the internal sound pressure level (measured in the hot test).

Data from both firings for the 12 accelerometer channels were reduced by 100-cps bandpass filters over a 10 - 2,000-cps region; it was apparent from this reduction that the levels were constant throughout the firing except for starting transients. A 1.25-sec interval 20 sec after ignition was chosen for a frequency-spectrum analysis. A frequency-spectrum analysis was also performed, before ignition, for the purpose of determining a recording-system noise level; it was assumed that the level remained the same after ignition. In both analyses a 29-cps bandpass filter over a 15 - 1500 cps interval was used. No sinusoids or quasi-sinusoids were apparent.

It was noted that the vibration spectra at each location were quite similar, regardless of the orientation of the accelerometer. This was particularly apparent in the spectra of the bus feet and apex ring, and on foot A of the forward structure, the difference between the x and y orientation was especially noticeable.

The upper and lower bays of the solar panels illustrated similar spectra, with the higher accelerations appearing on the lower bay. The solar-panel accelerometers were mounted perpendicular to the panel in the center of each bay. Calibration levels of the accelerometers were set high, in expectation of the high acoustically induced wideband vibration levels. As a result, the recording-system noise level (especially 60 and 120 cps) makes reduction of the low-frequency (15 - 1500 cps) portion of the data spectrum difficult. However, run and pre-run frequency-spectrum analyses were performed on data from three spacecraft locations that were known to have large low-frequency structural gains.

Table IX is a comparison of the hot-test data and the applicable noise-burst specifications on a basis of maximum power spectral density and wideband rms level. In the case of the bus feet and the solar panels, the maximum PSD's induced by the firing were in excess of the JPL flight-acceptance vibration specification and the tangential measurements of Bus Foot A and the solar panels were in excess of the Type Approval specification. The wideband (15 - 1500 cps) rms vibration level of all locations except the solar penals was below the wideband rms input level of the noise-burst portion of the applicable flight-acceptance specifications.

The solar-panel measurements illustrated the high vibration levels that could be induced by an intense acoustic field acting on a large flat surface. Levels recorded in the center of the panel bays exceeded specification levels. Such measurements indicated a response of the structure, whereas the specification levels were proscribed as inputs to the

Table IX. Comparison of Hot Test Data and Noise Burst Specification

Location	Direction	Hot Test Max PSD $8\ g^2/cps$	Hot Test Loop RMS g	Noise Burst Specification T A PSD $2\ g^2/cps$	F A PSD $2\ g^2/cps$	T A RMS g	F A RMS g
Apex Ring	Y	.0025	.85	---	---	---	---
Apex Ring	X	.00075	.64	---	---	---	---
Foot A, Fwd. Str	X	.0080	1.1	---	---	---	---
Foot A, Fwd. Str	Y Y	.011	1.3	---	---	---	---
Box #4, Flange	X	.0015	1.1	.16	.088	15.	12.
Bus Foot D	Z Z	.015 *	2.7	.037	.0077	7.5	3.5
Bus Foot A	Tangential	.027 **	2.6	.0095	.0077	3.75	3.5
Bus Foot A	Radial	.0084 *	1.7	.0095	.0077	3.75	3.5
Bus Foot A	Z	.010 *	2.1	.037	.0077	7.5	3.5
Top of Boom	Y	.0015	.74	.16	.088	15.	12.
Solar Panel Top Bay	X	.33 **	8.8	.0095	---	3.75	---
Solar Panel Bottom Bay	X	.42 **	9.0	.0095	---	3.75	---

NOTES:

1. RMS values given for 15 - 1500 cps bandwidth.
2. (*) indicates Hot Test PSD in excess of Flight Acceptance (FA) noise burst specification PSD.
3. (**) indicates Hot Test PSD in excess of Type Approval (TA) noise burst specification PSD.
4. Specification Power Spectral Densities (PSD) are nominal values.

The fact that the bus feet exhibited a response PSD that exceeded the nominal PSD of the Flight Acceptance specification does not indicate that the specification is inadequate. The specification also prescribes a sinusoidal input sweeping from 40 to 1500 cps. Such an input has an infinite PSD at the frequency of the sinusoid. Hence, the areas where the measured bus foot response PSD was greater than the nominal noise burst PSD will be covered by the sweeping sinusoid portion of the specification. The significant point to note is that the over-all specification rms value was above that of the test data.

attachment points of the unit. It was expected that the structural gain between the panel mounts and the panel center would be sufficient to amplify the vibration test levels to approach those of the hot test, at least at low frequencies near the panel resonances.

Although the vibration levels appeared to be similar in each method of excitation, the methods were distinctly different; furthermore, the damage-producing potential of the two methods was not necessarily equivalent.

The hot-test data supplied the beginning correlation between known sound-pressure levels, and resultant vibration levels produced on certain spacecraft components. For this purpose, it was assumed that nearly all the vibration present was acoustically caused, by exciting the spacecraft either through coupling with the vehicle and shroud, or directly after transmission through the shroud.

Both the internal and external wideband sound-ptessure level at the base of the shroud was 134 db. If it was assumed that the vibration levels were directly proportional to sound pressure levels, the hot-test levels should have been increased by 40% to correspond to the maximum noise level (136.7 db at liftoff) observed at the forward end of an Atlas/Agena A. Table X illustrates the hot-test wideband vibration levels extrapolated to correspond to a 136.7-db internal noise measurement. Wideband levels for the flight-acceptance noise burst are also shown for the locations where a test input is prescribed, in the case of the bus feet, the extrapolated levels were similar to the specification input levels. The validity of the assumptions involved in this extrapolation was undetermined.

CONCLUSION

The recorded vibration response of the spacecraft to the high-level acoustic field generated by the hot test indicated that the Ranger spacecraft PTM and the flight-acceptance test levels adequately represented the acoustically induced vibration that would be encountered. It would appear, however, that the adequacy of the noise-burst portion of the spacecraft flight-acceptance test was marginal if the extrapolated values in Table X were correct; for then the Ranger assembly flight-acceptance noise burst would contain a large margin of safety.

Since the test levels were designed merely to simulate the deleterious effects of the vibration which accompanies Atlas and Agena motor burning, a better determination of the vibration environment could be obtained only upon analysis of actual flight measurement.

NASA was notified that the Air Force was planning to discontinue the hot firings at Santa Cruz Test Base on September 19, 1962. Since NASA was to assume complete cost of the facility if it were to be kept operative, MSFC requested that JPL comment on the value of the tests (Ref. 49). JPL answered that the value of these tests did not warrant their continuation, but that adequate data from earlier Agena flights should be made available (Ref 50).

Table X. Extrapolated Spacecraft Vibration Levels

Location	SCTB Hot Test (1)	Atlas-Agena A Lift Off (2)	Flight Acceptance Noise Burst
Apex Ring, Y	0.85 g rms (3)	1.2 g rms (3)	---g rms (3)
Apex Ring, X	0.64	0.9	---
Foot A, F.S., X	1.1	1.5	---
Foot A, F.S., Y	1.3	1.8	---
Box #4, X	1.1	1.5	12.0 (4)
Bus Foot D, Z	2.7	3.7	3.5) (5)
Bus Foot A, Tang.	2.6	3.6	3.5) (5)
Bus Foot A, Rad.	1.7	2.4	3.5) (5)
Bus Foot A, Z	2.1	2.9	3.5) (5)
Top of Boom, Y	0.74	1.0	12.0 (4)
Solar Panel Top Bay, X	8.8	12.	---
Solar Panel Bottom Bay, X	9.0	13.	---

(1) Internal noise level 134 db, 15 - 1500 cps

(2) Internal noise level 136.7 db, 15 - 1500 cps

(3) 15 - 1500 cps bandwidth

(4) Ranger assembly Flight Acceptance Specification 30201

(5) Ranger system Flight Acceptance Specification 30222

2. Smoke Tests

a. Preliminary Smoke Tests. Smoke tests were conducted at LMSC (Van Nuys) February 28 to 29, 1961, on shroud and spacecraft materials which were to be used in the Ranger program (Table XI). Originally, the tests were to determine (1) the extent of smoke generation caused by aerodynamic heating of shroud materials, and (2) the effect of smoke deposits on JPL specimens. However, the JPL specimens were not used in these tests.

Five quartz lamps were used as a heat source (Ref. 51) in the tests which were conducted within a 9 in-diameter bell jar. Suitable mounts were provided inside the bell for test specimens, a radiant heat reflector, and temperature instrumentation. A vacuum gage was used to monitor the internal pressure continuously. At the start of each test, the initial pressure was 9 mm Hg. Temperatures were recorded through the use of iron-constantan thermocouple wire which was spot-welded directly to the test specimens. All interior surfaces were cleaned after each test to remove contaminants which may have been deposited.

These smoke tests were entirely qualitative in nature (Ref. 52). No means were used to determine the amount of reduction in transmittance caused by the deposit on the glass and, in fact, no permissible limits had as yet been established by JPL for the optics of the spacecraft. The materials were tested individually; no checks were made to determine possible interactions which might occur.

Table XI. Smoke Tests

Sample No.	Sample Description and Procedure	Deg/Sec Rate of Heating	Temperature Reached, °F	Vacuum Pressure[a] mmHg	Results
1	0-ring P/N 1062947-1, 5 in. long, clamped to a sheet of 0/071 anodized magnesium alloy HM 21A-T8.	10	350[b]	9	No smoking or outgassing noted; glass slide not contaminated.
2	Preparation same as No. 1, except that 0-ring coated with Dow Corning DC-55.	10	350	9	No visible smoking occurred; slide contaminated with light film of grease, assumed to be DC-55.
3	Preparation same as No. 2, except that 0-ring coated with Dow Corning DC-33.	10	350	9	No visible smoking occurred; light film of oil noted on slide. (Film lighter than that on No. 2)
4	Preparation same as No. 3, except that 0-ring coated with silicone high-vacuum lubricant.	10	350[c]	9	No visible smoking occurred; very slight fogging of glass slide.
5	Anodized magnesium alloy HM 21A. Spot welds were sprayed with zinc chromate primer.	15	800	9	Slide showed foggy deposit and contamination, assumed due to zinc chromate.
6	Anodized magnesium alloy HM 21A.	15	800	9	No smoke or contamination noted.
7	Same as No. 6, except that back side coated with Products Research Primer #PR 1902.	15	800	9	Smoking and fairly heavy contamination of slide noted. Blue deposit, of same color as primer; also noted on aluminum base and holding fixtures.

Table XI. Smoke Tests (continued)

8	Same as No. 7, except that coating of silicone cement and catalyst PR 1930-4 applied over primer.	15	800	9	Silicone started blistering at 500-600°. Smoking occurred, and vacuum pressure rose to 10.6 mm. Silicone turned deeper shade of orange-red. Heavy bluish deposit on glass, as well as oily-appearing material. Silicone bubbled out about 1/8 in. from magnesium sheet. Separation complete except for outer edges; blue primer seemed to be the problem.
9[d]					
10	Anodized magnesium sheet HM 21A-T8, coated with Englehard Co. type CA9R cement.	15	800	9	Excessive smoking noted. Vacuum pressure rose to 12 mm. Distinct odor when jar removed, and oily film, quite heavy, deposited on blass, bar holder, and aluminum base plate.
11	Same as No. 6, except coated with silastic Q3-0079 adhesive	15	800	9	Smoke noted at 400°; heavier at 800°, and large bubbles formed in material. Heavy deposit on slide and on sample-holding fixture in bell jar.
12	Same as No. 6, except that 6-in. length of GGS-22-AT wire clamped to sheet.	15	800	9	No smoking of sample or contamination of glass slide noted.

Table XI. Smoke Tests (continued)

13	Sintered beryllium sheet 2 in. x 2 in. x 0.071 in.	18	1000	---	Aluminum heat shields melted, causing deposit on glass. Test rescheduled for next day.
14[e]					

[a] In all tests, the vacuum pressure was to be maintained constant for 2 min at temperature reached.

[b] Temperature actually reached 350°F on sample 1.

[c] Temperature over-run of 25°F occurred, after which it was permitted to fall to 350°

[d] Sample was to have been same as No. 8, except for application of a 2 in. x 2 in. beryllium sheet cemented to magnesium sheet by silicone cement. Silicone did not set up, so new specimen prepared for later testing.

[e] Test No. 14 was to involve specimens furnished by JPL, but were not tested at this time. Instead, specimens were to be tested later in another series involving special truncated nose cone.

Further tests on shroud materials were made on a continuing basis through March and April 1961. Thermo-gravimetric analyses were made wherein substances were heated to predetermined maximum values, smoke and sublimate formations were analyzed, and weight loss was measured. In most case, the analyses included recommendations.

The following analysis was made in March 1961 (Ref. 53):

Material	Alternate Material or Method
Beryllim nose cap	Preheat at 300-350°F for 5 min
Adhesive-backed aluminum foil	Use aluminum foil capacitance welded in place
Radiation heat shield of fiberglas-phenolic	Use shield of alternating aluminum and ceramic paper
Permacel type P-621	Mechanically fasten
Silastic Q3-0079	Mechanically fasten
PR 1902 primer and PR 1930-4 cement	Seal with an inorganic cement
Silicone grease DC-33	Use molybdenum disulfide power
Fluorolube GR-362	Use molybdenum disulfide powder
A-MD 12-09 wire	Use micatemp wire, Hi-temp. VM-215 with an aluminum-foil jacket
Zinc chromate touchup on Dow 19 and Dow 17 on magnesium	Use Dow 19 only for touchup

On April 18 to 19, 1961, LMSD conducted three tests on selected shroud materials to determine their effects on JPL quartz optic samples (Ref. 54). In the analyses, the remaining transmissivity and reflectivity of the samples were measured as a function of wavelength.

Optic samples contained in these tests were one couvette, one plane-glass sample, two Lyman-alpha mirror samples and three quartz samples. The mirror and the quartz samples, both furnished by JPL, were to be used to determine the smoking effect upon: the Lyman-alpha telescope mirror; and the Sun and Earth sensors, solar panels, and temperature-control surfaces, respectively.

In the first test, the material samples were heated at 13°/sec, until they reached 750°F; they were held at this temperature for 2 min; the pressure was then released and the optic samples were prepared for examination. Materials used in this test were:

Beryllium (nose cone)
Magnesium Thorium (shield)
Dow 17 (internal coating of shroud)
Dow 19 (placed where Dow 17 is removed during manufacture)
Microtemp wire (antenna coupler)

Aluminum sheet (heat shield)
Fiber Frax (dome heat shield)
Rusco BX 750 (seal cement)

During the test, outgassing was indicated by an increase in the internal pressure from 9-22 mm of mercury. The beryllium broke away from the Rusco cement and fell against the heating lamps, and the test was stopped so that the samples could be rearranged. At the beginning of the test the top part of mirror sample no. 1 was visibly fogged; however, this fog re-vaporized as the test proceeded. The temperature reached by the material samples, prior to failure of the beryllium adhesive, was 350°F. After the beryllium was clamped into place and the nitrogen purged, heating of the samples was resumed. The test was then completed as prescribed.

In the second test the same procedure was used; the bell jar was first purged with nitrogen and then pumped down to 9 mm of mercury before heating of the shroud samples. Samples were heated, at 10° sec, to 350°F and held there for 2 min. The shroud materials used were:

Magnesium Thorium (shroud material)
Dow 17 (internal shroud coating)
Silicon 0-ring (shroud seal)
Down Corning high-vacuum grease (0-ring lubrication)

Outgassing or smoking did not appear in any visible form during the test; however, when the Lyman-alpha mirror, the glass sample and the couvette were closely examined, a very slight deposit could be seen.

Test No. 3 was performed on Red Cerro Cement, which is used as a bonding agent for shroud temperature gages. Other items in this test were magnesium thorium and Dow 17. The cement was tested alone, from the previous high-temperature materials, since it had not been decided whether or not it would be used. The temperature of the material sample was increased at 13°/sec, to a maximum of 750°F and held there for 2 min. There was visible outgassing of the material, and a very heavy fog remained on the glass sample and couvette. The resistance temperature gage peeled away from the magnesium thorium plate at about 350°F.

The results from the analysis of the JPL quartz optic samples used in these tests indicated that the transmissibility had been reduced by 2-4%. Five of the Lyman-alpha mirror samples indicated that, at the Lyman-alpha wavelength, reflectivity was reduced by 1 1/2-3%. The other Lyman-alpha mirror indicated a reduction of approximately 57%. As a result of the test on the Red cerro Cement, it was decided not to use it in the shroud.

b. Removal of adapter diaphragm. With the fiberglass diaphragm in the adapter, it had not been necessary, from the spacecraft point of view, to prevent the use of outgassing materials in either the launch vehicle or the adapter. After the decision had been made to remove this fiberglass diaphragm from the adapter for the Block III flights, an action item was accepted by LMSC to report on adapter and shroud outgassing materials. LMSC began its review after a structural coordination meeting was held at Sunnyvale on July 9, 1963.

Outgassing materials were found definitely to exist within the adapter (Ref. 55). Cadmium-plated parts, zinc chromate dissimilar-metal protection, ink markings, rubber gaskets, irradiated polyolefin wire jacketing, dry-film lubricants, and nylon-connector contact fillers were found to evaporate, smoke, or outgas in measurable quantities at the temperatures expected for certain areas within the adapter and shroud. Corrective action consisted of the following:

(1) Cadmium plating

(a) Cadmium-plated steel screws, nuts, and nut plates were replaced with silver-plated, corrosion-resistant steel fastenings of similar type, except for a few screws which were replaced by titanium fasteners.

(b) Cadmium-plated detail design parts such as bolts, pins, nuts, and washers were stripped of their plating and given manganese phosphate coating.

(c) Cadmium-plated electrical connectors, as well as the electrical rotary disconnect at the spacecraft interface, were replaced with components having gold irridite finish.

(d) Cadmium-plated terminal-board buses were replaced with silver-plated parts.

(2) Zinc Chromate

Zinc chromate dissimilar metal protection was replaced with epoxy-based resin EPI Bond 123.

(3) Ink Marking

All visible signs of ink marking on the adapter were washed with methyl ethyl ketone and thereby removed.

(4) Rubber

Rubber gaskets were removed.

(5) Irradiated Polyolefin

Wires which were jacketed with irradiated polyolefin and which were subjected to temperatures exceeding 140°F were double-wrapped with aluminum foil. In areas not exceeding 200°F, the foil was retained by pressure-sensitive silicone adhesives. Aluminum foil on harnesses subjected to temperatures above 200°F was retained by string ties. In some cases, it was necessary to replace existing wires with teflon-coated wire (480°F) or high-temperature mica insulated wire (1000°F), since foil wrapping was inadequate.

(6) Lubricant

Dry-film lubricant Type I (200°F) was replaced by Type II (500°)

(7) Nylon

Nylon-connector contact fillers in high-temperature areas were replaced by teflon fillers.

These actions were all taken to minimize the degradation of cleanliness in the spacecraft cavity and to prevent contamination of the spacecraft itself, both of which might have been incurred when the diaphragm was removed.

c. Atlas/Agena separation gases. Early in 1964, LMSC investigated the problems associated with possible impingement of the Atlas retromaneuver combustion products on the Mariner Venus spacecraft (Ref. 56). The results of the investigation also applied to Ranger spacecraft (Ref. 57).

Atlas/Agena separation is assisted by the firing of two retrorockets mounted on opposite sides of the Atlas/Agena adapter; their thrust axis is aligned 7.75 deg from the vehicle longitudinal centerline. In the region of the spacecraft, it is calculated that during the entire burn time only 2/1,000,000/lb of gas particles will pass through an area 1-in. square normal to the gas flow direction. The amount of gas which will adhere to surfaces parallel to the flow direction will be less than this value.

The method of characteristics was used in a computer program to calculate the flow. Calculations were based on the following rocket characteristics:

Chamber pressure	725 psia
Chamber temperature	5014 deg Rankine
Ratio of specific heats	1.256
Nozzle-area ratio	7.16
Nozzle half-angle	8 deg, 21 min
Gas, molecular weight	26.3 BTU/lb deg R
Nozzle-exit diameter	2.0 in.
Burn (action time)	0.925 sec

For each rocket, the weight per unit area that would strike a surface normal to the flow, during the entire burn time, is plotted against distance from the nozzle in Fig. 35. The average value over the length of the spacecraft is approximately two millionths of a pound per square in. normal to the flow direction. The composition of the exhaust gases is given in Table XII.

Two Atlas retrorockets were fired successively at a simulated altitude of

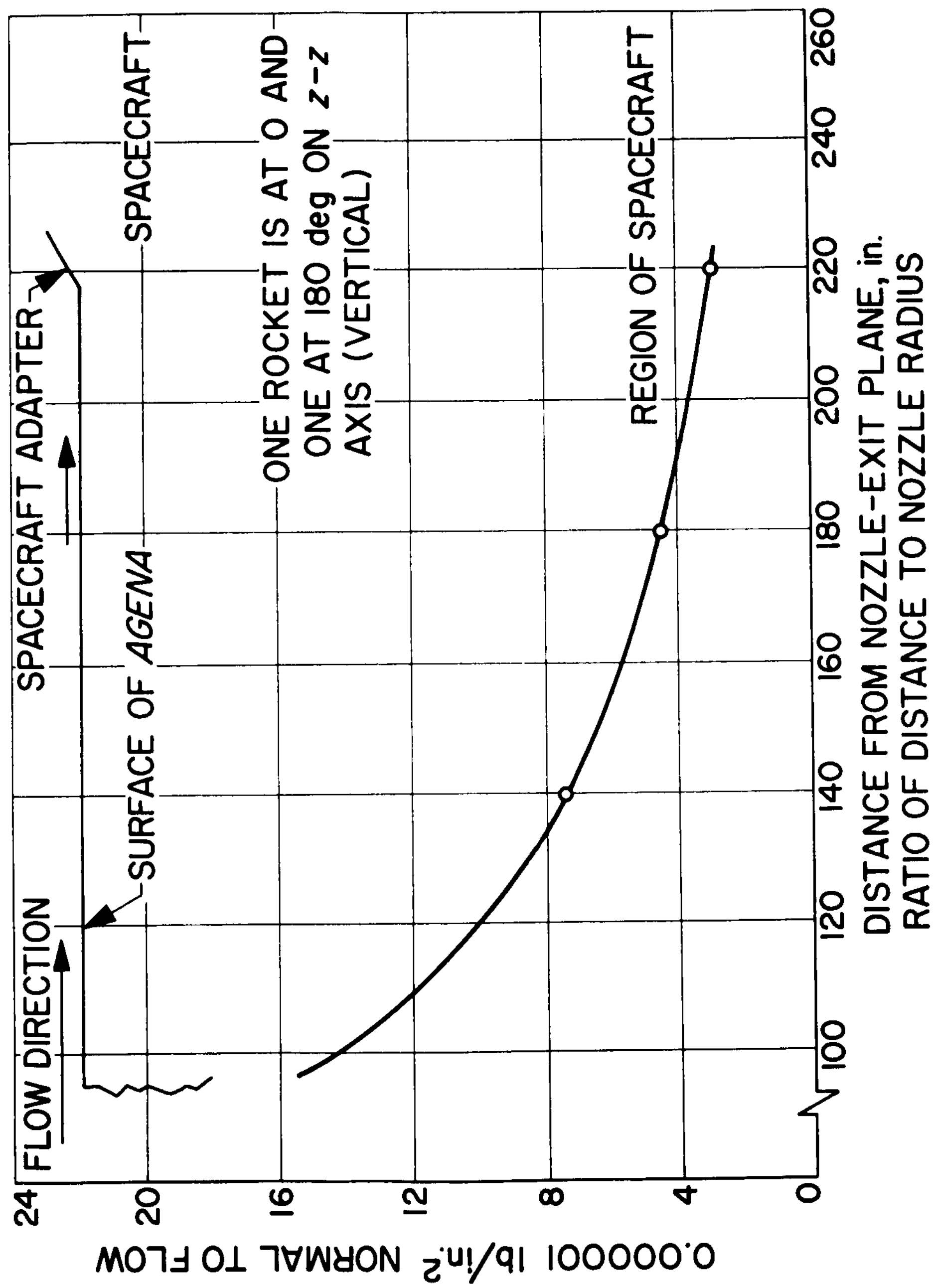


Figure 35. Atlas Retro-rocket Exhaust Gases

300,000 ft in the 60-ft vacuum facility at the NASA Langley Laboratory. The exhaust gases were allowed to impinge on sheets of aluminumized mylar, oriented normal to the flow, during the Program 823 shroud-development tests. The distance between the rockets and the aluminumized mylar was the same as the distance from the rockets to the bottom of the spacecraft. However, the successive firing of two rockets in the same location, and containment of all the gases in the 60-ft-sphere test chamber were considered to be an overtest, since more material could be expected to collect on the mylar than would collect in space. A thin film could be seen on the mylar.

The emittance of these mylar samples was then measured at the LMSC Research Laboratory (Palo Alto). Room-temperature emittance for the complete spectrum was measured from 7-40 m. The samples were then cleaned and re-measured. There was no change of emittance to the accuracy of the measurements (1%).

Contamination of the spacecraft by the Atlas retrorocket exhaust gases appeared to be unlikely; however, if positive assurance was desired, verification could only be obtained by the performance of contamination tests of typical spacecraft surfaces and electronic equipment under simulated space conditions.

Table XII. Products of Combustion from Atlas Retro Rocket

Exhaust Gas Constituent	Weight Per Cent	Exhaust Gas Constituent	Weight Per Cent
H_2O	23.80	COS	Trace
HCl	24.20	Hs	Trace
CO_2	23.10	$MgCl_2$	Trace
CO	11.70	SO	Trace
H_2	0.84	Cl	Trace
N_2	9.65	H	Trace
H_2S	4.44	CS_2	Trace
S_2	1.50	NH_3	Trace
SO_2	0.37	OH_3	Trace
	99.60 subtotal		0.40 subtotal
			100.00 Total

Metal additives: Iron and Aluminum powder, 2% by weight, each

3. Temperature Control

Control of the thermal interface for the Ranger spacecraft, after it was mated with the launch vehicle, was the responsibility of LMSC. JPL provided information to Lockheed concerning the dissipation of power versus time (power profile), the location of components on the spacecraft, and the operating-temperature limits of the components.

In order that a compatible thermal environment be provided for the spacecraft, the final design for thermal control placed several constraints upon the Agena shroud. Among these was a requirement for on-pad cooling of the spacecraft during checkout and launch operations, a constraint upon the inner-shroud wall temperature during boost, and a minimum altitude for shroud ejection. Additionally, a requirement for the minimum parking-orbit altitude was established.

The ground cooling system selected consisted of an air conditioner located at the base of the umbilical tower; the ducting necessary to carry the air to the top of the launch vehicle; and a cloth blanket wrapped around the shroud, which distributed the conditioned air and maintained a uniform temperature on the outer surface of the shroud. Earlier Thor-Agena vehicles had used the same type of system. Since the use of this system meant that no air would be introduced under the shroud, the shroud compartment could be not only previously sterilized, but also but also maintained in a sterile condition. The latter was a requirement for Block II.

Two tests of the ground cooling system were made prior to its use on Ranger I. In the first (conducted at Van Nuys in April 1961), the flight-type launch-vehicle hardware and a dummy-payload equivalent heat source were used. No problems were encountered.

In the second test (conducted at JPL), a live spacecraft was inside the shroud. Although the air conditioners at JPL were not adequate enough to provide the specified flow rates and temperatures, the test results, when converted to the design conditions convinced all concerned that the design was adequate. Subsequent use of the design on Ranger justified the above conclusion.

Some means was required for protecting the spacecraft from the high shroud temperatures which would be experienced during the ascent phase of the flight. If protection were not provided, certain components of the spacecraft would over heat. An engineering analysis determined that a temperature not over 500°F and a surface emittance of not over 0.1 were safe values and established limits below which the spacecraft would not be damaged. To maintain these limits, a thin polished aluminum shell was installed on the inner surface of the shroud for use as a radiation shield. Analysis indicated that the temperature of the shield would be well below the 500°F limit, and no ground tests were deemed to be necessary. Subsequent flight data verified the analysis.

The shroud-jettison altitude for the Agena trajectory had been designed to occur high enough that extremely low aerodynamic heating rates would be felt by the spacecraft only after the jettison; therefore, no constraint was actually placed upon this parameter. A minimum altitude which would hold the aerodynamic heating rate at injection to an acceptable level, had been determined for the parking orbit. This minimum altitude became a constraint upon the launch vehicle. Flight temperatures showed no indications of any aerodynamic heating effects.

Tests were conducted in the Lockheed Static Test Hangar on June 22, 1961. The test temperatures simulated critical aerodynamic heating and were conducted on a nose-cone assembly, including radiation shields and antenna coupler.

Purposes of the tests were to determine: the structural soundness of a nose-cone structure; and the internal temperatures occurring at designated areas when in a simulation of critical aerodynamic heating, the nose cone was subjected to externally applied heat.

The test specimen consisted of the nose-cone assembly, an omnidirectional-antenna coupler and a thermal radiation shield. The nose-cone assembly was mounted upright on the test stand, and radiant-heat lamps were arranged uniformly about the external surface of the structure. Test heating was applied with 1,000 T-3 radiant-heat lamps; power was supplied and controlled by Westinghouse Ignitron and Lockheed automatic-control equipment.

Nose-cone, radiation-shield, and antenna-coupler tempera tures were measured with thermocouples recorded by a Brown automatic recorder and Visicorder. The thermocouples used for control of test temperatures were located on the skin, midway between structural rings and away from any components.

The desired temperatures, as shown in Fig. 36, were applied twice during a 0-140-sec period. All temperature recorders were turned on simultaneously at zero time, and temperature readings were taken continuously during the test time interval.

Summary of Results

The nose-cone assembly showed no visual damage caused by external heating (which simulated critical aerodynamic heating). Tabulated data was accumulated, and plots were made showing temperature vs time for each thermocouple.

4. End-to-End Calibration

Measurements of in-flight vibration had been made on all Ranger I - VII flights; however, the accuracy of the measurements had not been determined. In June 1964 a review of the instrumentation and calibration techniques which had been used up to that time was requested (Ref 58). An evaluation was deemed necessary since it was held that the validity of results, in the analysis of acceleration and vibration data, depended to a varying degree upon the gain and phase characteristics (or complex transfer function) of the overall measurement system.

During the previous philosophy, it had been assumed that calibrations of individual components could be relied upon and that they were sufficient to construct a representative model of the dynamic environment from the data received (Ref 59). It was possible at that time for instruments to be received from a manufacturer and placed in a launch-vehicle recording system without a check of their individual characteristics. Furthermore, the

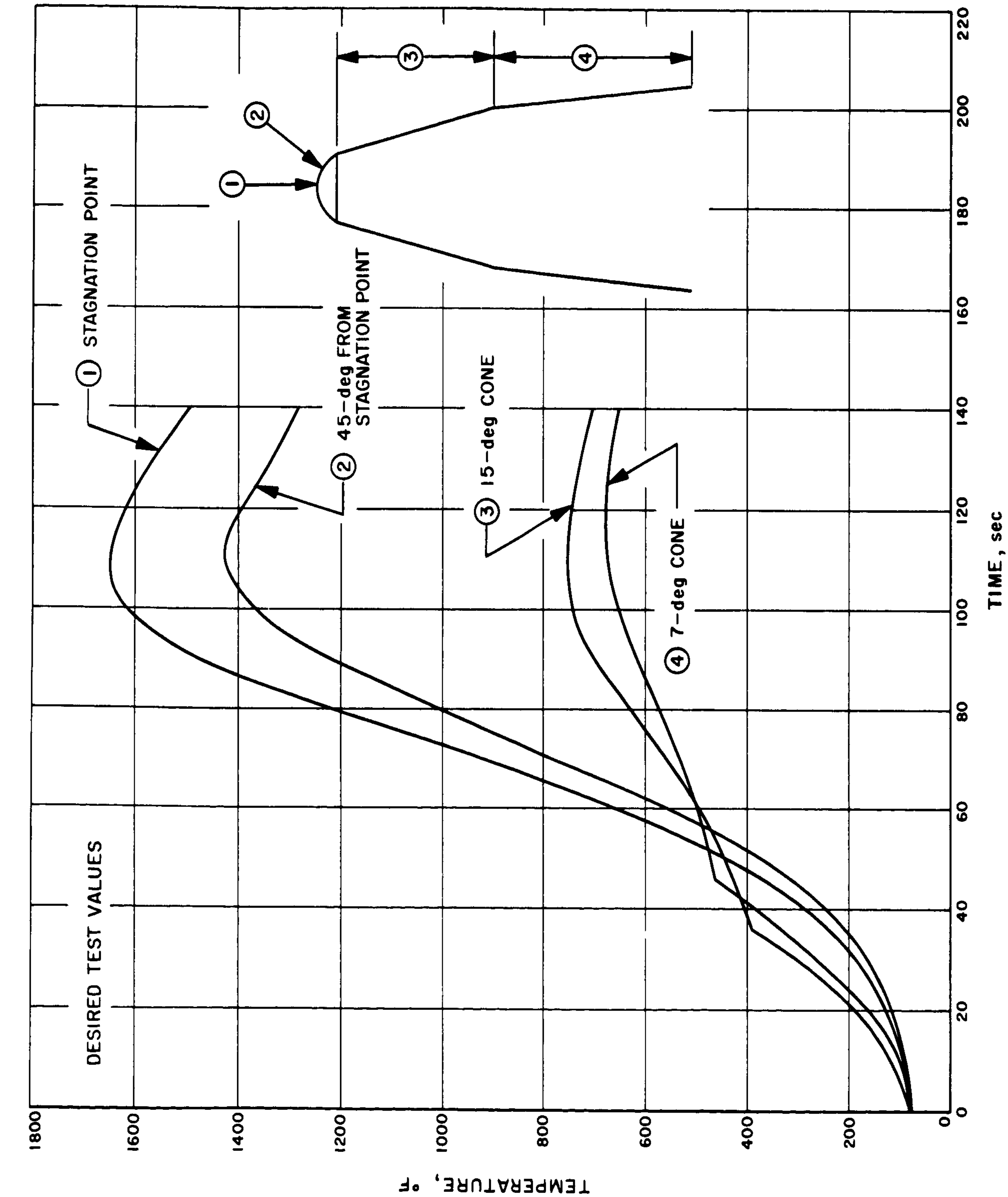


Figure 36. Ranger Nose Cone Ascent Temperatures

data received from the system was expected to provide the information required without the benefit of an overall system calibration. For these reasons, the quality of the data, in terms of the power spectral density (describing data of a random characteristic), the shock spectrum (defining data of a transient nature), and a Fourier analysis (describing periodic data), was unknown. More sophisticated analyses, wuch as the determination of cross-spectral densities, correlation coefficients, or coherence functions could not be attempted unless gain and phase functions were completely defined for the measurement system.

After a series of conferences, and upon receipt of information that a complete end-to-end, full-range shaker calibration was in use at AFETR in the Polaris program, it was proposed (Ref 60) that this facility be made available for the calibrations of Ranger VIII and IX instrumentation. This facility was made available and was used for the last two Ranger flights (Ref 61 and 62).

In general, the method of accomplishing end-to-end calibration consisted of physical excitation of the transducers by means of an electrodynamic shaker, transmission of the signal through the complete vehicle telemetry system to a receiver, and recording of the composite telemetry signal on magnetic tape (Fig. 37). A reference transducer signal was also recorded by means of a wideband FM recording system used to measure the physical input. For convenience and repeatability, the shaker motion was programmed by a pre-recorded magnetic tape which contained sinusoidal signals varying in frequency from 5 - 3000 cps, a complex wave consisting of five sinusoids not related harmonically, and two random-noise signals with nominal bandwidths of 1000 cps and 4000 cps. The schematic diagram of the calibration system is also shown in Fig. 37. In addition to the calibration signals obtained from the programmed tape, static calibrations using the Earth's gravitational field were recorded where applicable.

The reference transducer and its associated amplifier were calibrated by an independent testing agency over a frequency range of from 30 - 2000 cps. The worst accuracy quoted was 5% (at the higher frequencies). This calibration indicated the system response to be flat within ±5% over the calibrated range. From previous independent manufacturer's calibrations, this had been assumed to be true over a greater range, i.e., from 20 - 3000 cps.

Manufacturer's published data was used to determine the error in the recording and reproducing systems (voltage-controlled oscillator, discriminator, and low-pass filter) due to non-linearity, drift, stability, and frequency response characteristics; the error was conservatively estimated to be ±5%. Thus, a total error of ±10% was estimated - again conservatively - for amplitude measurement.

Since each measurement system phase was based upon an arbitrary time reference, the error in phase was essentially cancelled. The absolute phase response was therefore not required for the comparison of two or more measurement systems. However, an error did exist in the relative phase functions, at frequencies close to dc, because of the high-pass filter nature of the Endevco reference measurement system. This could have been eliminated by substituting a measurement system with dc response for determining the input accelerations at low frequencies.

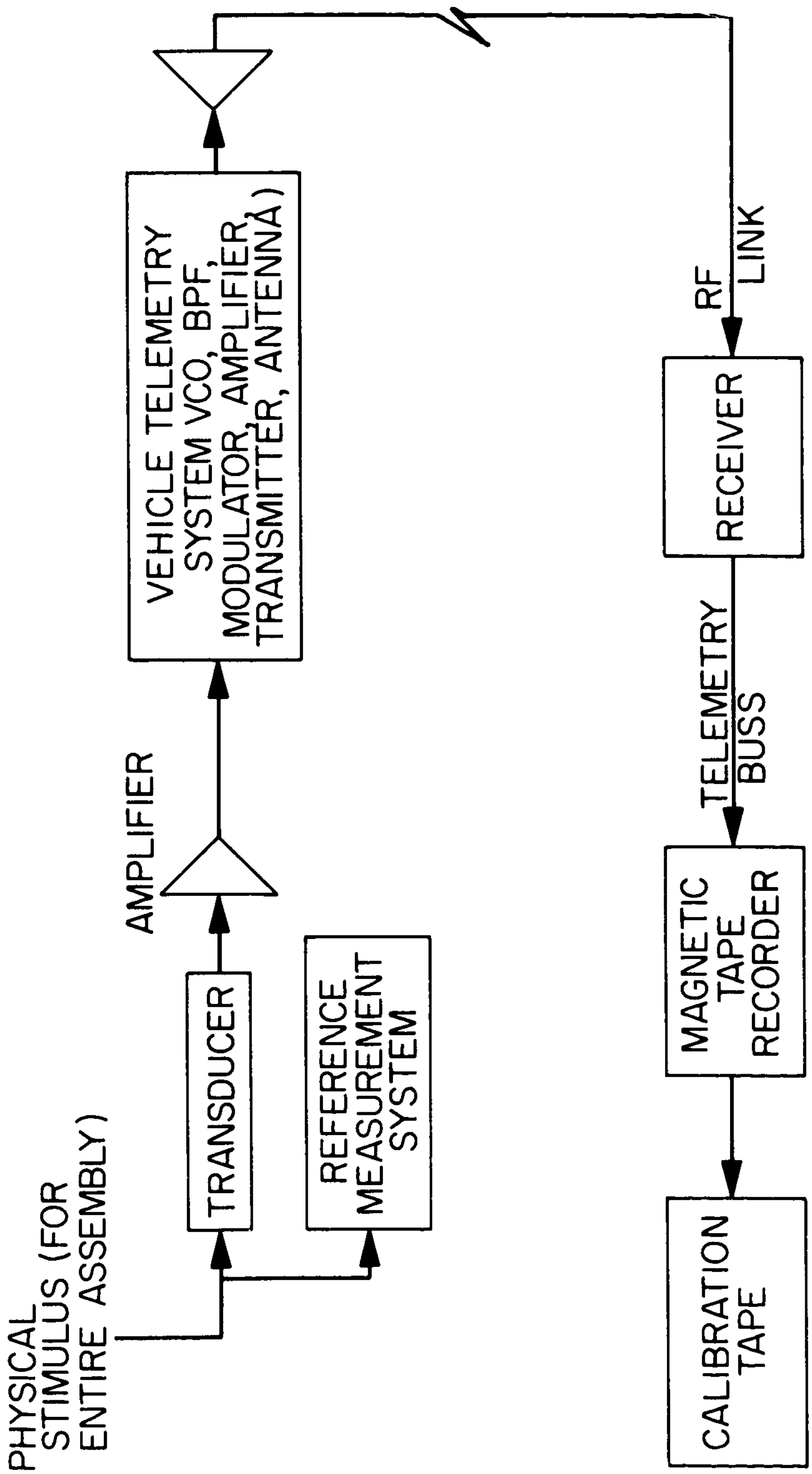


Figure 37. Instrument Calibration System

The end-to-end calibration yielded results of increased accuracy, and it supplied additional information about the complete system performance information which could not have been acquired by piecewise calibration or analysis. The technique also supplied a means for comparison between various data reduction systems by providing an overall calibration source. A choice of processing techniques could be made independently among various users of the flight data without conflict of results.

Determination of system gain and phase functions also allowed for correction of reduced data or for immediate correction during the processing phase. Once the raw data had been properly corrected for these effects, any amount of sophistication which might be desired was made possible through the further reduction of data.

The transfer functions determined from these tests were based upon the sinusoidal calibrations. Techniques were also found to be available for evaluating random-vibration inputs and under certain restrictions, estimates of the system noise spectrum and signal-to-noise ratios could be determined. It was recommended that these techniques be developed and evaluated for comparison with the sinusoidal results. If they developed, then only a short burst of random noise would suffice for a calibration, in place of the time-consuming sinusoidal series. Another recommendation was to improve the low-frequency response information by incorporating a reference-measurement system with dc response.

APPENDIX A

VEHICLE SERIAL NUMBERS

Appendix A shows the relationship of spacecraft serial numbers, Block numbers, Agena serial numbers, spacecraft/adapter drawing numbers, and Atlas booster serial numbers for each of the various flight configurations. Because of the weight-saving program which appeared in the design for Block III, the adapter diaphragms were omitted in these flights. In some cases the fiberglass diaphragm was actually sawed from an already-assembled adapter; in other cases, adapters were assembled without diaphragms. These differences are indicated under the "Remarks" columns.

Spacecraft	Block No.	Agena Serial No.	Adapter Drawing No.	Atlas Serial No.	Remarks
Ranger I	I	6001	1314318	111D	
Ranger II	I	6002	1314318	117D	
Ranger III	II	6003	1314318	121D	
Ranger IV	II	6004	1314318	133D	
Ranger V	II	6005	1314318	215D	
Ranger VI	III	6008	1359755	199D	New adapter built without diaphragm
Ranger VII	III	6009	1360210 1338541	250D	Adapter reworked from the Mariner Venus spare (built without diaphragm)
Ranger VIII	III	6006	1360224 1314318	196D	Adapter reworked from one originally fabricated to Ranger Block II drawings
Ranger IX	III	6007	1359755	204D	New adapter built without diaphragm

APPENDIX B

LAUNCH-ON-TIME EXPERIENCE

The following is a summary of the problems encountered for Ranger flights during the period from start of countdown to launch. Problems, holds, and cancellations are listed for each mission. Figure 38 displays the countdown interruptions occurring during each attempt and gives the total number of days in the various launch periods, the launch attempts per launch, and the window penetration prior to launch (Reference 64).

Ranger I

There were five attempts to launch the Ranger I/Atlas IIID/Agena 6001 vehicle:

1. The first attempt, on July 29, 1961, was scrubbed at T minus 27 minutes because of industrial and Cape critical power failures.
2. The second attempt, on July 31, 1961, was scrubbed prior to entrance into the Atlas portion of the countdown because of a leak in the spacecraft attitude-control system.
3. The third attempt, on August 1, 1961, was scrubbed at T minus 15 minutes when LOX transfer valve LB1 stuck open. LOX had been detanked in order that an Agena oxidizer tank low-pressure indication could be investigated.
4. The fourth attempt, on August 2, 1961, was scrubbed prior to entrance into the Atlas portion of the countdown because the spacecraft pyrotechnics were inadvertently fired.
5. In the fifth and final attempt to launch Ranger I, countdown was started at 19:27 EST on August 22, 1961, and resulted in liftoff 22 minutes, 10.26 sec after the start of the 63-minute launch window. At T minus 50 a hold was called which lasted 28 minutes to allow for service tower removal, and for the performance of checks on the Atlas displacement gyro torquing circuitry. At T minus 5 another hold was called lasting 9 min because of a guidance temperature problem.

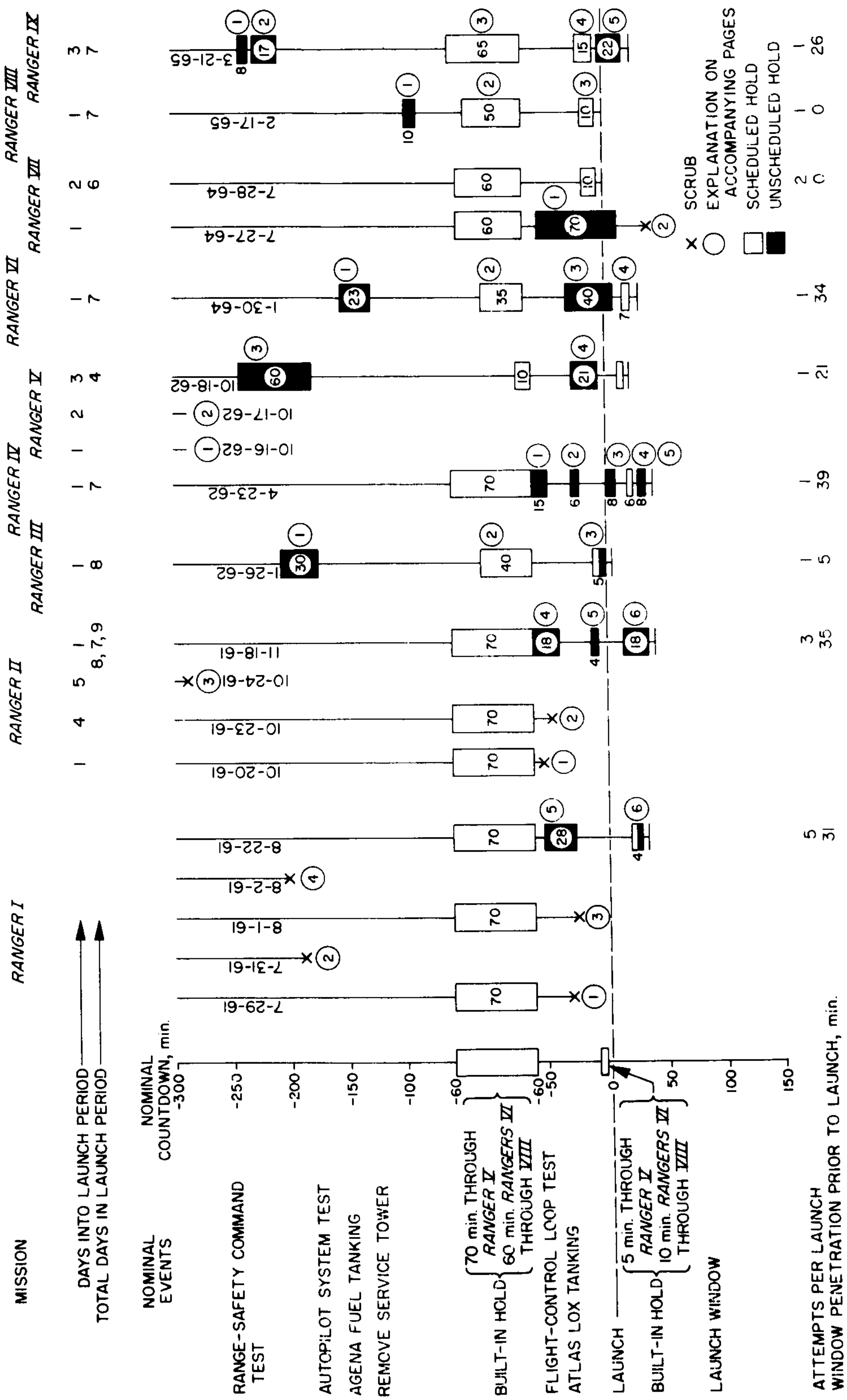


Figure 38. Launch-on-Time Experience

Ranger II

The Ranger II/Atlas 117D/Agena 6002 vehicle was launched on November 18, 1961. The first launch attempt was scheduled for the night of October 19, 1961, but was unsuccessful.

1. The countdown on October 19 progressed smoothly until T minus 45 min after the Atlas autopilot guidance loop test. The "initiate separation sequence" discrete did not reach the autopilot programmer, and the problem could not be resolved in time to launch within the window. The problem was later found to be due to an open circuit in a three-way splice; wire ZB 131A22 to pin A of plug 301U3P1 on the GE guidance decoder had pulled out of the splice.
2. The flight was rescheduled for October 22, and then postponed to October 23 in an effort to reduce the magnetic field at the magnetometer, when the spacecraft was returned to the hangar for replacement of some components. On October 23 the countdown proceeded smoothly to about T minus 40 min when another cancellation was required because of a hydraulic fluid leak in the Atlas V2 engine.
3. A third countdown attempt was cancelled when word was received from Lockheed that the Agena could not be cleared for launch because of hydraulic problems encountered in an inflight failure of a Discoverer on the previous day.
4. The fourth and final countdown for the Ranger II vehicle was on November 18, 1961. At T minus 60 min, an 88-min hold occurred. The first 70 min had been planned to meet launch-window requirements; however, replacement of the service tower around the missile (for the purpose of an Agena guidance check) required an 18-min extension.
5. At T minus 31 min a hold was called for 4 min because of a frozen valve in the LOX tanking system.
6. At T minus 5 min an 18-min hold was called because of oscillations on the Gilmore-weight digital readout panel during subcooled LOX topping. The actual LOX level was determined by slightly raising the LOX tank pressure to dampen the oscillations.

Ranger III

The Ranger III/Atlas 121D/Agena 6003 vehicle was launched from AFETR Complex 12 on January 26, 1962, after several minor holds.

1. At T minus 205 min a 30-min hold was called so that igniter installation of the Atlas engines could be completed.

2. A 70-min hold had been planned for T minus 60 min to meet launch window requirements

3. At T minus 5 min a 10-min hold was called. The first 5 min had been planned to meet window requirements. This was extended 5 min so that LOX topping could be completed.

Ranger IV

The Ranger IV/Atlas 133D/Agena 6004 vehicle was launched from AFETR Complex 12, on April 23, 1962.

1. At T minus 60 min an 85-min hold was called. The 70-min hold planned was extended for 15 min as umbilical P1005 was inadvertently knocked out early in the hold. The pneumatic-panel differential-pressure warning light came on, indicating a false zero bulkhead differential pressure, and subjected the missile to Sequence II pressures. The umbilical was re-installed and restepped to Sequence I pressures which were satisfactory.
2. At T minus 40 min a hold which lasted for 6 min was called so that GE evaluation of loop test No. 2 could be completed.
3. At T minus 15 min an 8-min hold was called so that LOX tanking could be completed.
4. At T minus 5 min a 6 min hold occurred, as planned, to meet launch-window requirements. Launch Plan 23G was established.
5. At T minus 2 min 27 sec a hold was called which lasted for 8 min due to a GE guidance redline callout. The count was immediately recycled to T minus 5 min. The ground guidance track transmitter power was low due to a faulty cabinet door interlock in the guidance ground station. This situation was corrected and GE guidance reported a "go" condition at 1540 EST. The launch plan was revised to 23H and the countdown was resumed at 1545 EST, proceeding through launch without further difficulty.

Ranger V

Ranger V/Atlas 215D/Agena 6005 was launched from AFETR, Complex 12, on October 18, 1962, on the third day of its four-day launch period.

1. Due to spacecraft problems encountered prior to the first launch day the attempt was postponed for one day.

2. The launch attempt was rescheduled for the third day of the launch period because of an unfavorable weather prediction (Hurricane Ella).

3. At T minus 245 a hold was called which lasted 60 min to replace the power supply and the voltage regulator in the S-01 telemetry system.

4. At T minus 25 a hold was called which lasted 21 min to further evaluate the wind conditions and complete LOX tanking in the Atlas.

Ranger VI

The Ranger VI/Atlas 199D/Agena 6008 vehicle was launched from AFETR Complex 12 at 15 hr 49 min 09.092 sec Zulu, on the first countdown during the first day of the firing period.

The launch countdown proceeded normally, with holds called as follows:

1. A hold was called at T minus 155 min due to a problem with the Atlas fuel tanking operation. This hold lasted 23 min.

2. A scheduled hold was called at T minus 60 min, with a duration of 35 min.

3. A hold was called at T minus 15 min. The GE guidance ground station lost a power supply and replacement of the module and validation caused an extension of the hold. The hold was extended three times, with a total duration of 40 min.

4. A scheduled hold at T minus 7 min lasted 7 min 2 sec.

Ranger VII

The Ranger VII/Atlas 250D/Agena 6009 space system was launched from AFETR Complex 12 at 16 hr 50 min 07.873 sec Zulu on the second attempt the second day of the firing period, July 28, 1964. The countdown proceeded smoothly to firing without any unscheduled holds.

On the first attempt holds were called as follows:

1. At T minus 51 min a 70-min hold was called to allow replacement of an Atlas telemetry battery.

2. At T minus 22 min a hold was called because of a GE Mod IIG ground guidance problem. The launch was then scrubbed since the problem could not be resolved in time to meet the launch window requirements.

Ranger VIII

The Ranger VIII/Atlas 196D/Agena B6006 vehicle was launched as scheduled on the first day of the launch period. Liftoff was at 17:05 hr GMT on February 17, 1965, less than 1 sec into the window.

1. At T minus 100 min a 15-min hold was called to remove a colored flag from the launch vehicle. The flag was marked "Do Not Remove", and was left on inadvertently. Only 10 min of the allotted time was actually needed. The hold was called at 14:15 hours and lasted until 14:25 hours GMT.
2. At T minus 60 min the scheduled 60-min hold was cut down to 50 min to make up for the previous unscheduled hold. This scheduled hold began at 15:15 hours and lasted until 15:55 hours GMT.
3. At T minus 7 min a scheduled 10-min hold took ;lace. This hold began at 16:48 hours and lasted until 1658 hours GMT.

Ranger IX

The Ranger IX/Atlas 204D/Agena B6007 vehicle was launched as scheduled on the third day of the launch period. It was decided that there would be no attempt to launch on the first two days of the launch period because of relatively poor lighting conditions at the most desirable target point on the Moon. Liftoff was at 21:37 GMT on March 21, 1965, 26 min after opening of the window.

Because of the urgency of getting off within the short (63 min) window on this day, the two built-in holds at T minus 60 min and at T minus 7 min were rescheduled for 90 min instead of 60 min and 15 min instead of 10 min respectively. Three unscheduled holds were called in addition to the regular built-in holds just mentioned.

1. At T minus 255 min (15:11 GMT) an unscheduled hold was called because of an Agena velocity meter check. This hold lasted for 8 min.
2. At T minus 240 (15:34 GMT) an unscheduled hold was called for completion of blockhouse tests. This hold lasted for 17 min.
3. At T minus 60 (18:51 GMT) the scheduled 90-min hold (see paragraph above) was reduced to 65 min to make up the time lost in previous unscheduled holds.
4. At T minus 7 min (20:49 GMT) the 15-min scheduled hold was called.
5. At T minus 3 min (21:08 GMT) another unscheduled hold was called due to the necessity for review of an anomaly in the Agena velocity meter readings. The hold lasted for 22 min. At 21:30 GMT the countdown was resumed by recycling to T minus 7 min and proceeded to a successful launch at 21:37 GMT.

APPENDIX C

SPACECRAFT/AGENA B INTERFACE RELATED DRAWINGS

Appendix C is a list of Lockheed Missile and Space Company (LMSC) drawings which were received at JPL for the Ranger program. Aperture cards for all of the drawings are on file in appropriate locations. The Block III interface drawings for Ranger are identified by a single asterisk (*). Toward the latter part of the program some drawings were known to have been revised and others were known to exist, but these were never received by JPL. Drawings requested by JPL are marked with a double asterisk (**), and other drawings pertaining to Ranger are marked with a triple asterisk (***).

SIZE	DRAWING NUMBER	DASH NO.	CHG LTR	TITLE	RESP. DIV.	DWG STAT	RELEASE DATE MO.	RELEASE DATE YR.	VENDOR CODE	USED ON	NEXT ASSEMBLY	OFF COL	SEQUENCE NUMBER
		•		INTERFACE DRAWING									
		••		LATER REVISION HAS BEEN									
				REQUESTED FROM LMSC.									
		•••		INTERFACE DRAWING--LATER									
				REVISION HAS BEEN									
				REQUESTED FROM LMSC.									
				DATE OR V IN REL. DATE									
				COLUMN INDICATES									
				APERTURE CARD ON FILE.									
D	1022223		A	DOME NOSE CONE			06	60	LMSC				
C	1062152		J	SQUIB ELECTRICALLY FIRED			05	63	LMSC				
C	1062493		G	PLUG ELECT UMBILICAL			06	61	LMSC				
B	1062494		C	RECEPTACLE ELEC UMB			10	60	LMSC				
C	1062593		G	NO TITLE			V		LMSC				
C	1062928	•	E	BOBRICK VALVE			06	62	LMSC	RA B3			
B	1062943		C	PACKING O RING			11	60	LMSC				
B	1062947		A	SEAL RUBBER			08	60	LMSC				
J	1062958			NASA PAD 12 RF LINK			09	60	LMSC				
A	1068956			SPEC SPRING MECHANISM			V		LMSC				
A	1072317			PIEZO ACCELEROMETERS			12	63	LMSC	RA B3			
A	1072318			STATHAM CA CARRIER AMPL			12	63	LMSC	RA B3			
	1072326			STATHAM CA CARRIER AMPL			V		LMSC	RA B3			
A	ECI 1072390			ATS PIN PULLER SQUIB ACT			V		LMSC				
A	1072404	••		MATCHING STRAIN GAGE			05	59	LMSC	RA B3			
	1072425	••		TITLE UNKNOWN #SPEC#					LMSC				
A	1072503	••		ENDEVCO VIBRATION AMPL			12	63	LMSC	RA8 B3			
A	1072664		A	PIEZO ACCEL & AMPLIFIER			12	63	LMSC	RA8 B3			
J	1300809		D	CHART TLM INST			V		LMSC				
J	1303383		B	INSTRUMENTATION INST			08	60	LMSC				
J	1303387		A	INSTRUMENT INSTL			02	60	LMSC				
J	1303397			INST INSTL NOISE MIC			04	59	LMSC				
A	ECI 1303978			INSTR INSTL ACCEL & AMPL			V		LMSC				
J	1303998		C	INST INSTL ACCEL AMP			05	60	LMSC				
J	1305820			RING-STA NOSE CONE			05	59	LMSC				
C	1306155		A	XDUCER & CARRIER AMPL			06	60	LMSC	RA B3			
D	1306434		C	WIRING DGM			10	60	LMSC				
J	1306549		A	INTERFACE LMSD-DAC			08	59	LMSC				
C	1306941			SHELL-SPRING MECH			07	59	LMSC				
J	1307007		C	STRUCTURE AFT MDBODY			08	59	LMSC				
J	1307008			STRUCTURE INSTL			08	59	LMSC				
J	1307011		B	FAIRING INSTL MDBODY			12	59	LMSC				
J	1308295			INST INSTL ACCEL AMP			10	59	LMSC				
J	1308301			INST INSTL ACCEL			09	59	LMSC				
C	1308303		B	BRACKET ACCELEROMETER			09	59	LMSC				
C	1308308		B	XDUCER & CARRIER AMPL			11	62	LMSC	RA8 B3			
J	1308428		B	INTERFACE DWG			12	59	LMSC				
J	1308806			STRUCT INSTL ENGINE			10	59	LMSC				
C	1308962		A	DISCONNECT ASSY EXPL			06	60	LMSC				
J	1310030			SUPPORT INSTL TURB			01	60	LMSC				
C	1310511	•••	C	VHF ANTENNA INSTALLATION			12	62	LMSC	RA B3			
C	1312217			RECEPTACLE EXIT			09	60	LMSC				
D	1312985			BASE PLATE EXPLOS			04	60	LMSC				
C	1313206		A	EXPLOSIVE DISC ASSY			06	60	LMSC				
C	1313199			BASE PLATE ASSY			04	60	LMSC				
H	1313543	•		BASIC CONFIG-MODEL 10205			V		LMSC	RA B3			
J	1313544	•		BASIC DIMENSION- 10205			V		LMSC	RA B3			
D	1313545			VEHICLE UMBIL DISCONNECT			06	60	LMSC				
J	1313546			SPACE ALLOVATION			05	60	LMSC				
J	1313547	•••	D	VEHICLE ALIGNMENT DWG			V		LMSC	RA B3			
J	1313548	•••	D	FINAL ASY COMPLETE 10205			01	62	LMSC	RA B3			
J	1313549	•	A	INBOARD PROFILE			02	62	LMSC	RA B3			
J	1313550	•	D	VEHICLE PAINT & MARKINGS			04	62	LMSC	RA B3			
B	1313552		B	FINAL ASSY ADAPTER			09	60	LMSC				
J	1313553		C	STRUCTURE ASSY ADAPT			03	61	LMSC				
B	1313554			EQUIP INSTL BOOSTER			07	60	LMSC				
D	1313555		A	FINAL ASSY VEHICLE			05	60	LMSC				
J	1313556		A	STRUCTURE ASSY VCLE			05	60	LMSC				
J	1313557			EQUIP INSTL VEHICLE			06	60	LMSC				

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SIZE	DRAWING NUMBER	DASH NO.	CHG LTR	TITLE	RESP. DIV.	DWG STAT	RELEASE DATE MO.	YR.	VENDOR CODE	USED ON	NEXT ASSEMBLY	OFF COL	SEQUENCE NUMBER
H	1313558		A	EQUIP INSTL-			08	60	LMSC				
D	1313559			EQUIP INSTL MID SECT			07	60	LMSC				
D	1313560			EQUIP INSTL AFT SECT			07	60	LMSC				
J	1313562			DUCT INSTL WIR HNS			04	60	LMSC				
R	1313564	*	E	STRUCTURE FWD MIDBODY			10	63	LMSC	RA B3			
J	1313602		A	TANK INSTL GAS STORAGE			07	60	LMSC				
C	1313625		A	SEQUENCE TIMER ASSY			12	62	LMSC				
C	1313651			CLIP-WEB EQUIP RACK			05	60	LMSC				
A	1313668			SPRING POT SEPARATON			01	61	LMSC				
B	1313669			COLLAR SP RETAINING			05	60	LMSC				
C	1313670	**	A	POTIENTIOMETER ASSY			12	62	LMS				
J	1313690			UNITIZED FM TELEMETER			06	60	LMSC				
K	1313724			FUNCTIONAL DIAGRAM			09	60	LMSC				
A	1313757			TELEMETER SYS			12	60	LMSC				
A	1313759			TELEMETER SYS			V		LMSC				
A	1313760			TLM SYS INSTR SCHEDULE			V		LMSC				
A	1313761			TELEMETER SYS			12	60	LMSC				
D	1313772	***		FINAL ASSY S/C SECTION			08	63	LMSC	RA B3			
J	1313773	***	C	STRUCTURE S/C JPL SECT			06	63	LMSC	RA B3			
D	1313774	***	B	EQUIPMENT PAYLOAD SECT			03	62	LMSC	RA B3			
D	1313775		D	FINAL ASSY S/C SECTION			12	62	LMSC				
J	1313847			ASSEMBLY C BAND ANT			06	60	LMSC				
	1314042			WEB ASSY QUAD 1 & 2			V		LMSC				
A	1314118		C	NO TITLE			V		LMSC				
J	1314245		B	INTERFACE S/C TO AGENA			03	62	LMSC				
H	1314301	***	E	NOSE CONE ASSY			10	64	LMSC	RA B3			
J	1314302	*	F	STRUCTURE ASSY NOSE CONE			06	62	LMSC	RA B3			
J	1314303		B	RING STA 9360			07	60	LMSC				
J	1314304		B	RING STA 9360			07	60	LMSC				
B	1314305		B	RING STA 12052			07	60	LMSC				
J	1314306		B	RING STA 12052			07	60	LMSC				
J	1314307		B	RING STA 14255-20715			07	60	LMSC				
J	1314308		B	RING STA 21965			07	60	LMSC				
J	1314309		B	RING STA 23250			07	60	LMSC				
J	1314310		B	FITTING NOSE CONE			07	60	LMSC				
D	1314311		B	FITTING SPRING SPT			07	60	LMSC				
D	1314312		B	PLUG VENT NOSE CONE			07	60	LMSC				
D	1314313		B	BOSS VENT NOSE CONE			07	60	LMSC				
K	1314318	*	G	STRUCTURE S/C JPL SPT			12	62	LMSC	RA B3			
J	1314319		A	RING STA 23250			07	60	LMSC				
J	1314320		A	RING STA 24450			07	60	LMSC				
J	1314321		A	FITTING SPACE CRAFT			07	60	LMSC				
J	1314322		A	FITTING EJECTION SPG			07	60	LMSC				
J	1314323		A	FITTING ADAPTER			08	60	LMSC				
D	1314324		A	TEE ADAPTER DR FRAME			07	60	LMSC				
J	1314325		E	DIAPHRAGM ASSY ADAPT			02	61	LMSC				
C	1314326		B	BUMPER ADAPTER ANT			05	63	LMSC				
C	1314327		A	INSERT ADAPTER ANT			08	60	LMSC				
C	1314332		A	ANGLE RING SPACECRFT			07	60	LMSC				
B	1314334			WASHER GUIDE EJ PYLD			06	60	LMSC				
B	1314335			WASHER EJECTOR PAYLD			06	60	LMSC				
C	1314336			SPRING EJECTOR PAYLD			06	60	LMSC				
	1314337			PLUNGER EJECTOR			06	60	LMSC				
C	1314338			GUIDE EJECTOR PAYLD			06	60	LMSC				
C	1314339			PIN TIE PAYLOAD			06	60	LMSC				
C	1314340			GUIDE PIN TIE PAYLD			06	60	LMSC				
C	1314341			CLEVIS PIN PLULLER			06	60	LMSC				
C	1314342			PIN TIE NOSE CONE			06	60	LMSC				
K	1314343	***	D	INSTL NOSE CONE SPT STRV			06	62	LMSC	RA B3			
D	1314344			PISTON PIN PULLER			06	60	LMSC				
J	1314345		B	INSTL SPACECRAFT EJT			06	60	LMSC				
C	1314346			CLEVIS ASSY			06	60	LMSC				
D	1314347			PIN PULLER HOUSING			06	60	LMSC				
B	1314348			O RING NOSE CONE			06	60	LMSC				
D	1314349			PLUG PAYLOAD EJECTN SPG			06	60	LMSC				
D	1314350			O RING NOSE CONE			06	60	LMSC				
B	1314351			BUSHING ADAPTER			06	60	LMSC				
B	1314352			WASHER PIN PULLER			06	60	LMSC				
D	1314353			PIN PULLER ASSY			06	60	LMSC				
B	1314354			PLUG PIN PULLER			06	60	LMSC				
C	1314355			GUIDE ASSY			06	60	LMSC				
B	1314356			WASHER PIN PULLER			06	60	LMSC				
J	1314357		A	INSTL MID-BODY			V		LMSC				
C	1314359		A	GASKET DIAPHRAGM			06	60	LMSC				
J	1314597	*		COUPLER ASSY DIR ANT			09	60	LMSC	RA B3			
E	1314598			PARASITIC ANT ASSY			10	60	LMSC				
D	1314601	*		COUPLER ASSY PARABOL ANT			09	60	LMSC	RA B3			
B	1314904			WASHER THERMAL			06	60	LMSC				
B	1315152			CAVITY ASSY C-BAND ANT			06	60	LMSC				
	1315155			PROBE C BAND ANTENNA			06	60	LMSC				

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D	1315156			DIELECTRIC WINDOW C-BAND			06	60	LMSC				
A	1315276			NO TITLE			V		LMSC				
C	1315177			PLASTIC WINDOW C-BAND			06	60	LMSC				
J	1315278		B	EQUIP INSTL ANTENNA			06	61	LMSC				
J	1315280			EQUIPMENT INSTL			08	60	LMSC				
K	1315321		B	COMPONENT INSTALL			10	61	LMSC				
J	1315611		A	CHART TELE INSTR			06	61	LMSC				
C	1315617	•••	A	CHART TELEMETER INSTR			03	63	LMSC	RA B3			
C	1315618	•••	A	CHART TELEMETER INSTR			03	63	LMSC	RA B3			
C	1315619	•	A	CHART TELEMETER INSTRU			03	63	LMSC	RA6 B3			
C	1315620	•	A	CHART TELEMETER INSTR			03	63	LMS	RA7 B3			
B	1315648			SCREEN ASSY RF			09	60	LMSC				
J	1315649		C	EQUIP INSTAL COUPLER			09	61	LMSC				
C	1315650			SHIELD RF SCREEN			09	60	LMSC				
D	1315939	•	C	PIN PULLER ASSY S/C			06	63	LMSC	RA6 B3			
	1317041			RECEPT C BAND ANT			06	60	LMSC				
D	1317410		D	WIRING F/C&GUID			02	62	LMSC				
K	1317411		B	WIRING SQUIB 10205			03	62	LMSC				
K	1317412		B	WIRING PAYLOAD AGENA			12	62	LMSC				
K	1317413		E	WIRING TLM&BEACON			03	62	LMSC				
B	1317415		A	CABLE ASSY R F COAX			10	60	LMSC				
H	1317638			INSTR INSTAL			07	60	LMSC				
B	1318087			PIN LOCATING			07	60	LMSC				
D	1318088			FITTING STR SUPPORT			07	60	LMSC				
C	1318089			COVER STR SUPPORT			07	60	LMSC				
C	1318102			PISTON SPG MECH			07	60	LMSC				
C	1318103			SPRING MECH			07	60	LMSC				
C	1318146			PIN TIE NOSE CONE			07	60	LMSC				
C	1318147			CLEVIS PIN PULLER			07	60	LMSC				
C	1318148			CLEVIS PIN PULLER			07	60	LMSC				
C	1318171		A	PISTON PIN PULLER			08	60	LMSC				
C	1318172		A	PLUG PIN PULLER			08	60	LMSC				
B	1318194			HOUSING PIN PULLER			07	60	LMSC				
B	1318195			HOUSING PIN PULLER			07	60	LMSC				
B	1318223			TERMINAL BD ASSY			07	60	LMSC				
C	1318280			PIN TIE SC			08	60	LMSC				
B	1318281			WASHER TIE PIN PAYLD			08	60	LMSC				
C	1318282			GUIDE & ADJ SPR EJT			08	60	LMSC				
C	1318283			PLUNGER EJECT SC			08	60	LMSC				
D	1318284			PLUG EJECTOR SC			08	60	LMSC				
B	1318306			NUT ATTACH SC			08	60	LMSC				
K	1318310	•	A	DISCONNECT INSTL S/C SEP			12	62	LMSC	RA6 B3			
	1318679			WINDOW PARASITIC ANT			09	60	LMSC				
C	1319331			BRACE SUPPORT STR			09	60	LMSC				
C	1319332			BEAM SUPPORT STR			10	60	LMSC				
C	1319333			TIE SUPPORT STR			09	60	LMSC				
C	1319334			CLIP SUPPORT STR			09	60	LMSC				
C	1319335			STIFFENER SUPPORT			09	60	LMSC				
J	1319337		C	PLATE			09	60	LMSC				
J	1319338			CYLINDER ASSY			09	60	LMSC				
D	1319340			CONE ASSY			09	60	LMSC				
C	1319341			SLEEVE			09	60	LMSC				
D	1319342			FOAM SHEET ASSY			09	60	LMSC				
J	1319343			PLATE ASSY			09	60	LMSC				
C	1319387			WINDOW APERTURE			09	60	LMSC				
A	1319398			PROBE PARABOLIC ANT			09	60	LMSC				
D	1319450			CONE ANT COUPLER			09	60	LMSC				
D	1319457			PROBE ANT COUPLER			09	60	LMSC				
J	1319480			STIFFENER			10	60	LMSC				
J	1319505			EQUIP INSTAL			09	60	LMSC				
J	1319627			RING CENTER			09	60	LMSC				
J	1319628			RING FWD OMNI DIRECT			09	60	LMSC				
C	1319647			BRACKET ASSY			09	60	LMSC				
J	1319694			INSTRUMENTATION INST			09	60	LMSC				
J	1319695			INSTRUMENTATION INST			09	60	LMSC				
J	1319696			INSTRUMENTATION INST			09	60	LMSC				
C	1319755			COUPLER ASSY			09	60	LMSC				
C	1319757			SUPPORT COUPLER			09	60	LMSC				
E	1319797	•••		RECEPTACLE INSTL ELECT			10	60	LMSC	RA6 B3			
	1319798			CABLE MAIN JUNCTION BOX			V		LMSC				
	1320032			VEHICLE TEST PLAN			V		LMSC				
	1320033			VEHICLE TEST PLAN			V		LMSC				
E	1320180			CAVITY PARASITIC ANT			10	60	LMSC				
A	1320181			PROBE ASSY			10	60	LMSC				
C	1320362			DOOR ACESS			10	60	LMSC				
B	1320409			SHIM RF SCREEN			10	60	LMSC				
B	1320428			SHIELD NOSE CONE			10	60	LMSC				
J	1320441	•		DISCONNECT INSTL INSTR			11	60	LMSC	RA6 B3			
C	1320457			RF SCREEN LOWER			10	60	LMSC				
C	1320458			RF SCREEN UPPER			10	60	LMSC				

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C	1320459			RF SCREEN FWD VERT			10	60	LMSC				
D	1320462			BOLT ADJUSTMENT			10	60	LMSC				
C	1320475			BODY FEED			10	60	LMSC				
D	1320492			BOLT ADJUSTMENT SHEAR			10	60	LMSC				
D	1320493			BUSHING SERRATED			10	60	LMSC				
D	1320494			SPACER SHEAR TIE SC			10	60	LMSC				
D	1320495			SPACER TENSION TIE			10	60	LMSC				
C	1320496			SHIM-S1 TO AGENA			10	60	LMSC				
B	1320947			CLIP SUPPORT			11	60	LMSC				
H	1320973			FAIRING INSTAL			11	60	LMSC				
B	1321364		B	J BOX BATTERY INSTAL			11	60	LMSC				
A	1322197			NUT SPHER NOSE CONE			11	60	LMSC				
A	1322198			WASHER SPHERICAL			11	60	LMSC				
A	1322199			BUSHING SPHERICAL			11	60	LMSC				
A	1322214			PIN TIE NOSE CONE			11	60	LMSC				
A	1322216			SHIM WASHER			11	60	LMSC				
A	1322244			SHIM PLATE NUT ADPT			11	60	LMSC				
B	1322267			CABLE & SUPPORT ASSY			11	60	LMSC				
J	1322327			EQUIP INSTAL			11	60	LMSC				
B	1322332			SPACER-INDEX			11	60	LMSC				
A	1322333			PIN-TIE SPACECRAFT			11	60	LMSC				
B	1322339			SUPPORT ASSY-INSTRUM			11	60	LMSC				
B	1322395			BOSS-DIAPHRAGM ASSY			11	61	LMSC				
A	ECI 1322670			HEAT SHIELD ASSY			V		LMSC				
J	1322785		C	LINER INSTALLATION			06	62	LMSC				
C	1322786			LINER NOSE CONE			12	60	LMSC				
C	1322787			LINER NOSE CONE			12	60	LMSC				
C	1322788			LINER NOSE CONE			12	60	LMSC				
C	1322789			LINER NOSE CONE			12	60	LMSC				
C	1322790			LINER NOSE CONE			12	60	LMSC				
H	1322791			LINER ASSY NOSE CONE			12	60	LMSC				
H	1322792			LINER NOSE CONE			12	60	LMSC				
C	1322793			CLIP NOSE CONE THRM			12	60	LMSC				
B	1322794			FAIRING PAYLD EQUIPT			12	60	LMSC				
B	1322795			FAIRING EJECT SPRING			12	60	LMSC				
B	1322796			FAIRING PLUG			12	60	LMSC				
A	1322797			SPACER THRM INS			12	60	LMSC				
A	1322798			CLIP THRM INS			12	60	LMSC				
A	1322799			CLIP THRM INS			12	60	LMSC				
K	1322907	•		WEIGHTS INSTL NOSE CONE			12	60	LMSC	RA6 B3			
H	1323043			BASIC DIMENSIONS			V		LMSC				
J	1323111			CONE ASSY			03	61	LMSC				
D	1323127			DOME NOSE CONE AGENA C				61	LMSC				
K	1324563	•••	C	INSTL S/C MOUNTING			05	63	LMSC	RA6 B3			
A	1324586			TELEMETER SYS INSTR			V		LMSC				
J	1324833			LINER NOSE CONE			01	61	LMSC				
A	1324968			NUT ATTACH SC			01	61	LMSC				
A	1325100			SPRING MECHANISM			01	61	LMSC				
A	1325202			SHIM			01	61	LMSC				
J	1325539		B	WIRING DIA HORIZON			04	62	LMSC				
D	1325897			HOUSING PIN PULLER			03	61	LMSC				
C	1332028			WASHER PIN PULLER			03	61	LMSC				
	1332395			PLATE THERMAL MIXER BOX			V		LMSC				
A	1332635			BUFFER-EARTH SENSOR			04	61	LMSC				
J	1332671			DOOR SPACECRAFT			03	61	LMSC				
J	1332672						03	61	LMSC				
J	1332673			DOOR SPACECRAFT			03	61	LMSC				
J	1332674			DOOR SPACECRAFT			04	61	LMSC				
J	1332675			DOOR SPACECRAFT			03	61	LMSC				
J	1332676			DOOR SPACECRAFT			03	61	LMSC				
B	1332931			BRACKET MOUNTING ANT			04	61	LMSC				
B	1334573			BOLT ADJUST SHEAR			04	61	LMSC				
J	1335130			DIAPHRAGM ASSY			V		LMSC				
J	1335312	•	B	EQUIPMENT INSTL ANT CPLG			06	61	LMSC	RA6 B3			
K	1335595		C	JUNCTION BOX ASSY			06	61	LMSC				
B	1336140			WASHER S/C ATTACHMENT			07	61	LMSC				
A	1336174			VEHICLE TEST PLAN			V		LMSC				
J	1337869			SUPPORT ASSY RF ANT			09	61	LMSC				
A	1337981			BRACKET SPRING RET			08	61	LMSC				
J	1338541	•••	A	STRUCT ASSY PAYLOAD SPT			V		LMSC	RA7 B3			
C	1338653			FINAL ASSY			V		LMSC				
J	1338654			STRUCTURE ASSY			10	61	LMSC				
A	1338655			EQUIP INSTL			V		LMSC				
J	1338656		B	INTERFACE PAYLOAD			02	62	LMSC				
D	1338661			BRACKET PIN PULLER MON			10	61	LMSC				
A	ECI 1338710			TLM SYS INSTR SCHEDULE			V		LMSC				
A	ECI 1338715			CABLE ASSY RF COAX			V		LMSC				
A	1338717			WIR DGM HORIZON SENSOR			V		LMSC				
A	1338718			W/D POWER & UMBILICAL			V		LMSC				
A	1338719			W/D F/C & GUIDANCE			V		LMSC				

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SIZE	DRAWING NUMBER	DASH NO.	CHG LTR	TITLE	RESP. DIV.	DWG STAT	RELEASE DATE MO.	YR.	VENDOR CODE	USED ON	NEXT ASSEMBLY	OFF COL	SEQUENCE NUMBER
J	1338720		C	WIRING DIAGRAM SQUIB			V		LMSC				
J	1338721		B	WIRING PAYLOAD INFAC			04	62	LMSC				
J	1338722		B	TELEMETER & BEACON			04	62	LMSC				
C	1338815		A	DIAPH FWD MIDBODY			09	63	LMSC				
D	1338831			BRACKET SPT PAYLOAD ANT			09	61	LMSC				
J	1338842			PYRO ORDNANCE INSTAL			12	61	LMSC				
A	ECI 1338846			INTERCONNECT WIRING DGM			V		LMSC				
A	ECI 1338868			TERMINAL BD INSTL			V		LMSC				
A	ECI 1338883			VEHICLE TEST PLAN			V		LMSC				
J	1338899			DISCONNECT INSTL S/C SEP			10	61	LMSC				
J	1338900			DISCONNECT INSTL INSTRUM			10	61	LMSC				
A	ECI 1338918			VEHICLE TEST PLAN			V		LMSC				
C	1338919			DOUBLER BULKHD INSTR			10	61	LMSC				
D	1338961			BRACKET POTENTIOMTR MTG			10	61	LMSC				
J	1339812		A	WIRING DGM TLM CONTROLS			02	62	LMSC				
J	1340165			FAIRING DISCONNECT			11	61	LMSC				
D	1340178			FITTING SABE ARM			11	61	LMSC				
D	1340295			BOSS STERILIZATION			11	61	LMSC				
D	1340296			COVER STER FILTER			11	61	LMSC				
C	1340297			FITTING-OUTLET FILTE			11	61	LMSC				
A	1340300			PROGRAMMER FM/FM ASSY			V		LMSC				
D	1340438			BRACKET PAYLOAD ANT SPT			11	61	LMSC				
A	1340449			INSTR INSTL BOOSTER			V		LMSC				
J	1340501			EXPULSION INSTL			12	61	LMSC				
J	1340560			COMPONENT INSTL STER			12	61	LMSC				
C	1340610			BRACKET MONITER SWITCH			11	61	LMSC				
A	1342057	••		VEHICLE TEST PLAN			08	62	LMSC	RA8 B3			
	1342451	••		WIRING DGM TM FM/FM					LMSC	RA B3			
J	1342455	•		AGENA GROUND COOLING			01	62	LMSC	RA6 B3			
D	1342532	•		TOP SUMMARY ELECT MOD			05	62	LMSC	RA6 B3			
K	1342538	•••	A	WIRING DGM SQUIBS			11	62	LMSC	RA6 B3			
K	1342539	•	B	W DIAG S/C INTERFACE			05	63	LMSC	RA6 B3			
J	1342540	•••	D	WIRING DGM TLM & BEACON			04	64	LMSC	RA8 B3			
J	1342542		C	SCHEMATIC DGM			V		LMSC				
J	1342546	•••	D	HARNESS INSTAL PAYLOAD			V		LMSC	RA6 B3			
A	1342583	•••	B	INSTRUMENTATION SCHEDULE			02	64	LMSC	RA8 B3			
A	1342584	•••	B	INSTRUMENTATION SCHEDULE			03	64	LMSC	RA9 B3			
A	1342585	•	B	INSTRUMENTATION SCHEDULE			02	64	LMSC	RA6 B3			
A	1342586	•	A	INSTRUMENTATION SCHEDULE			V		LMSC	RA7 B3			
H	1342747		C	TELEMETER FM/FM			07	64	LMSC	RA B3			
C	1342748		B	TELEMETER FM/FM			07	64	LMSC	RA B3			
J	1342750		A	TELEMETER FM/FM			09	64	LMSC	RA B3			
C	1342751		B	WIRING DGM TLM FM/FM			09	64	LMSC				
C	1342752		A	WIRING DGM TM FM/FM			09	64	LMSC	RA B3			
C	1342754	••		WIRING DGM TM FM/FM			09	64	LMSC	RA B3			
K	1342755			SCHEMATIC DGM TM FM/FM			09	64	LMSC	RA B3			
K	1342756		A	SCHEMATIC DGM TM FM/FM			09	64	LMSC	RA B3			
K	1342758			SCHEMATIC DGM TM FM/FM			09	64	LMSC	RA B3			
D	1342844			COUPLER RF ANTENNA			02	62	LMSC				
J	1344673			EQUIP INSTL			05	62	LMSC				
C	1344954			BRACKET MTG TV CAMERA			04	62	LMSC				
C	1344955			BRACKET MTG TV CAMERA			04	62	LMSC				
E	1346851			COVER OUTER					LMSC				
J	1347062	•••	B	LIGHT INSTALLATION TV			07	64	LMSC	RA B3			
E	1347067			PANEL FWD ACCESS			06	62	LMSC				
J	1347331			INSTR INST XDUCR S/P SYS			04	62	LMSC	RA B3			
J	1347740	••	A	WIRING DGM TM & BEA			V		LMSC	RA9 B3			
	1347741	••		WIRING DGM TM & BEA					LMSC	RA6 B3			
	1347742	••		WIRING DGM TM & BEA					LMSC	RA7 B3			
C	1347998			BRACKET TV CAMERA			05	62	LMSC				
D	1349075			JUNCTION BOX ASSY			06	62	LMSC				
B	1350045			BRACKET ASSY			07	62	LMSC				
D	1350046			BRACKET ASSY MTG TV LITE			07	62	LMSC				
J	1350047			BRACKET ASSY			07	62	LMSC				
D	1351981			BUFFER EARTH SENSOR			09	62	LMSC				
D	1352961	••		BRACKET MTG TRANSDUCERS			10	62	LMSC	RA B3			
J	1352964			INSTR INSTL			10	62	LMSC				
	1354540	••		ACCELEROMETER & AMPL			12	63	LMSC	RA8 B3			
J	1354546			HOUSING SIGNAL CONDITION			01	63	LMSC				
D	1354943			BRACKET MTG XDUCER AMPL			12	62	LMSC	RA B3			
J	X1359245		A	SHROUD ASSY COMPLETE				63	LMSC				
J	1359331		B	SHROUD HALVES OGIVE CLAM			06	63	LMSC				
J	1359333		B	STRUCTURE ASSY SHROUD			08	63	LMSC				
J	1359354		A	STRUCTURE ASSY			07	63	LMSC				
K	1359755	•••	B	STRUCTURE ASSY S/C			08	63	LMSC	RA6 B3			
	1359962		A	INSTR INSTL PAYLD ADAPTR			08	63	LMSC	RA8 B3			
	1359963	••		INSTR INSTL PAY LOAD			02	65	LMSC	RA9 B3			
D	1359964	•	A	INSTRUMENTATION INSTL			06	63	LMSC	RA B3			
J	1359965		A	INSTR INSTL PAYLD ADAPTR				63	LMSC	RA7 B3			
J	1360210	•	A	STRUCTURE ASSY PAYLOAD			06	63	LMSC	RA7 B3			

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SIZE	DRAWING NUMBER	DASH NO.	CHG LTR	TITLE	RESP. DIV.	DWG STAT	RELEASE DATE MO.	RELEASE DATE YR.	VENDOR CODE	USED ON	NEXT ASSEMBLY	OFF COL	SEQUENCE NUMBER
J	1360218			CLAMP ASSY			05	63	LMSC				
	1360219	••		INSTL OF INSTR SHROUD					LMSC	RA B3			
J	1360224	•••	A	STRUCTURE ASSY PAYLOAD			06	63	LMSC	RA8 B3			
K	X1360585		A	RETAINER INSTL VERT SEP			08	63	LMSC				
A	1360726	•	A	VEHICLE TEST PLAN			06	63	LMSC	RA6 B3			
C	1360734			SUPPORT ASY PAD TV CLOCK			V		LMSC				
C	1360735	•		PAD TV CLOCK ACTUATOR			06	63	LMSC	RA B3			
K	1360738	•		THERMAL SHIELD KIT			06	63	LMSC	RA B3			
K	1360819	•		INSTRUMENTATION INSTALL			07	63	LMSC	RA B3			
J	1360836			BARREL ASSY AX/EJ SHROUD			06	63	LMSC				
J	1360850			SHROUD ASY STRUCT AX/EJ			V		LMSC				
E	1360851			LINER ASSY			06	63	LMSC				
	1360993	••		VEHICLE TEST PLAN					LMSC	RA9 B3			
	1360994	••		VEHICLE TEST PLAN					LMSC	RA7 B3			
J	1361287	•	C	INTERFACE DRAWING			V		LMSC	RA B3			
B	1361303			SUPPORT SOUND PRESS SYS			07	63	LMSC	RA B3			
D	1361306			SUPPORT ASSY SOUND PRESS			07	63	LMSC				
K	1361428	•		COMPONENT INSTALL			07	63	LMSC	RA B3			
K	1361510		A	INSTR INSTL SHROUD				63	LMSC	RA B3			
J	1361512		A	INSTR INSTL AXIAL ACCEL			09	63	LMSC	RA B3			
D	X1363190			FITTING SEP INIT TIMER			08	63	LMSC				
J	1363191			SEPARATION INIT TIMER			V		LMSC				
J	1363257		A	LIMIT STOP INSTALLATION			11	63	LMSC				
J	1363687	••		INSTR INSTL SHROUD			11	63	LMSC	RA B3			
E	1363688			INSTR INSTL AXIAL ACCEL			11	63	LMSC	RA B3			
J	1363689			INSTR INSTL RADIAL ACCEL			11	63	LMSC	RA B3			
D	1363873			STIFFENER CONICAL PAYLD			10	63	LMSC				
E	1364440		A	ADAPTER ASSY			12	63	LMSC				
D	1364466		A	HARNESS ASSY			02	64	LMSC				
E	1364467			RECPT ASSY			12	63	LMSC				
J	1364841			ROUGH CASTING			11	63	LMSC				
J	1364845			ROUGH CASTING DOOR FRAME			12	63	LMSC				
K	1365054			DOOR FRAME			12	63	LMSC				
K	1366905			WIR DGM S/C INTERFACE			06	64	LMSC	RA8 B3			
K	1366905			WIR DGM S/C INTERFACE			06	64	LMSC	RA9 B3			
D	1368031			BLOCK MTG VIBROMETER			09	64	LMSC				
D	1368032			BRACKET ASSY AMPLIFIER			09	64	LMSC				
C	1380180			CAVITY PARASITIC ANT			10	60	LMSC				
J	1395001			FORWARD SECTION			05	62	LMSC				
J	1395003			GUIDANCE MODULE					LMSC				
J	1395007			AFT SECTION ASSY			05	62	LMSC				
J	1395008			BOOSTER ADAPTER			04	62	LMSC				
J	1395013			VEHICLE ASSY			09	62	LMSC				
J	1395014			STRUCTURE FWD SECT			03	62	LMSC				
J	1395015			STRUCTURE ASSY			05	62	LMSC				
J	1395045			STRUCTURE ASSY			03	62	LMSC				
J	1395050		A	STRUCTURE AFT SECT			03	62	LMSC				
J	1395057			DOOR BAY 2			04	62	LMSC				
C	1395251		A	DOOR DESTRUCT ANT			02	62	LMSC				
J	1395272			DOOR BAY 6			04	62	LMSC				
J	1395273			DOOR BAY 7			04	62	LMSC				
C	1395292			ROD CONNECTING ASSY			02	62	LMSC				
C	1395293			FITTING ROD END			02	62	LMSC				
J	1395318			FORWARD DOOR BAY 1			04	62	LMSC				
J	1395337			PLATE SEQUENCE TIMER			02	62	LMSC				
C	1395338			HELIUM TANK PEDESTAL			03	62	LMSC				
J	1395365			AFT DOOR BAY 1			04	62	LMSC				
J	1395366			DOOR BAY 8			04	62	LMSC				
C	1395764			UMBILICAL DOOR			04	62	LMSC				
J	1395765			PANEL FUEL VENT			04	62	LMSC				
C	1395876			COUPLING ASSY			05	62	LMSC				
D	1396010	••	A	ELECT WINDOW ANT C BAND			05	62	LMSC	RA B3			
J	1397131	•••		C-BAND BEACON ANTENNA			05	63	LMSC	RA B3			
C	1397133	••		PROBE			04	63	LMSC	RA B3			
D	1397134			CAVITY ASSY C-BAND ANT			10	62	LMSC				
A	1410039			NO TITLE			V		LMSC				
A	1410296		A	SPEC SUPPORT STRUCT			01	61	LMSC				
A	1412507			DUMMY VALVE PROPELLANT			08	61	LMSC				
A	1412706	••	C	TELEMETER FM/FM TYPE 3			V		LMSC	RA B3			
	1412799	••	B	TELEMETER FM/FM					LMSC	RA B3			
A	1414247	•••	A	SEALING SPECIFICATION			08	63	LMSC	RA B3			
A	1414356	••	A	SPEC C&C SUBSYS 6006-9			06	63	LMSC	RA B3			
A	1414599		B	S-71A LAUNCH & HOLD LIMT			12	63	LMSC				
	1414606	••		PROGRAMMER TLM CONTROL			12	63	LMSC	RA B3			
C	1416462			AMPLIFIER-TRANSDUCER			08	62	LMSC	RA B3			
F	1460023		F	BLANKET TEMP CONT			V		LMSC				
D	1460647			EL CONNECTOR UMBILICAL			10	63	LMSC				
J	1460699		A	BLANKET TEMP CONTROL				64	LMSC				
B	1461028		A	DESIGN CONTROL DWG			01	64	LMSC				
B	1461057		A	CONNECTOR PLUG			01	64	LMSC				

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SIZE	DRAWING NUMBER	DASH NO.	CHG LTR	TITLE	RESP. DIV.	DWG STAT	RELEASE DATE MO.	YR.	VENDOR CODE	USED ON	NEXT ASSEMBLY	OFF COL	SEQUENCE NUMBER
D	1461471		C	TANK GAS STORAGE			V		LMSC				
D	1461485	•	E	TRANSDUCER SOUND PRESSUR			V		LMSC	RA B3			
E	1461702	•••	D	C-BAND TRANSPONDER TYPE			11	63	LMSC	RA B3			
D	1461970			CONNECTOR S/C R ANGLE			03	63	LMSC				
C	1461992	•	B	RECEIVER-DESTRUCT			03	63	LMSC	RA B3			
J	1501501		A	INTERCONNECT DIAGRAM			07	59	LMSC				
J	1501502		A	CABLE JB TO BHC			06	59	LMSC				
J	1501503		A	CABLE TYPE A			07	59	LMSC				
J	1511874		F	CABLING LAUNCH COMPX			V		LMSC				
J	1512562			SUPPORT CARD			05	60	LMSC				
J	1512566			DETAIL SCHEM GUID			07	60	LMSC				
J	1512567		C	DETAIL SCHEM LAUNCH			07	61	LMSC				
J	1512568		B	SCHEM VEH STATUS INC			10	60	LMSC				
E	1512573		B	DETAILED SCHEM PADIZ			04	61	LMSC				
J	1512574		B	DETAIL SCHEM TELEMTY			02	61	LMSC				
K	1512575			DETAIL SCHEM PNEU			10	60	LMSC				
D	1512576			DETAIL SCHEM FUEL			01	61	LMSC				
J	1512577			DEATAIL SCHEM OXID			11	60	LMSC				
J	1512578		B	DETAIL SCHEM GHS INC			04	61	LMSC				
J	1512579		C	DETAIL SCHEMATIC			06	61	LMSC				
K	1512580			DETAIL SCHEM GRD PWR			12	60	LMSC				
J	1512581		D	DETAIL SCHEMATIC SUBSYS			V		LMSC				
J	1512582			SCHEM AC-DC PWR DIST			12	60	LMSC				
J	1512583		A	SCHEM DIA AC & DC PW			04	61	LMSC				
J	1512584			DETAIL SCHEM UMBIL CABLE			11	60	LMSC				
J	1512654			CHASS ELECTRICAL EQU			06	60	LMSC				
E	1514624			BASE FRAME MOUNTING			11	60	LMSC				
J	1514654		A	DETAIL SCHEM PAYLOAD			02	61	LMSC				
D	1514695			PLATE CONN JPL BOT			10	60	LMSC				
E	1515114			CONNECTOR PANEL ASSY			09	60	LMSC				
E	1515115			PANEL CONNECTOR			09	60	LMSC				
E	1515121			RING CABLE ROUTING			10	60	LMSC				
D	1515186			PLATE CONN JPL TOP			10	60	LMSC				
D	1515187			CONN PLATE JPL TOP			10	60	LMSC				
D	1515195			CABLE ASSY CONSOLES			10	60	LMSC				
C	1515196			CABLE ASY READY CONT			10	60	LMSC				
D	1515198			CABLE ASSY JPL INSTR			10	60	LMSC				
D	1516113			PLATE CONNECTOR			10	60	LMSC				
J	1516114			CONN PLATE MAST TOP			10	60	LMSC				
J	1516115			CONN PLATE BOTTOM			10	60	LMSC				
B	1516116		A	CABLE ASSY SVC TOWER			10	61	LMSC				
E	1516117		A	JPL UMB WIRING DGM			11	60	LMSC				
E	1516121			CONN PLATE JPL BOT			10	60	LMSC				
B	1516142		A	CABLE ASSY JPL POWER			09	61	LMSC				
D	1516194			PLATE CONN JPL JB			40	60	LMSC				
D	1516195			CONN PLATE JPL JB			10	60	LMSC				
	1517413			CABLE ASSY			04	61	LMSC				
D	1517421			CABLE ASSY			04	61	LMSC				
J	1517435		C	DETAIL SCHEM TEMP			07	61	LMSC				
E	1517442			DETAIL SCHEM BOOM			01	61	LMSC				
D	1541483		D	UMBILICAL SYS AMR 12			08	64	LMSC				
J	1544146			JUNIOR RETRACTOR			09	63	LMSC				
J	1544654			CONTAINER S/C ADAPTER			08	63	LMSC				
J	1544802		D	CABLING			V		LMSC				
K	1544803			CABLE ASSY			11	63	LMSC				
J	1544996			HOISTING ADAPTER			10	63	LMSC				
J	1544997			SLING ASSY			10	63	LMSC				
J	1545366		C	MAST CABLING INST			V		LMSC				
E	1545569		A	DOLLY HANDLING SHROUD			03	64	LMSC				
J	1545752			GUIDE FIXTURE			12	63	LMSC				
E	1546244		A	HARNESS ASSY EL CABLE			V		LMSC				
J	1546379		F	CABLING LAUNCH COMPLEX			10	64	LMSC				
K	1546463			FIXTURE SUPPORT PAYLOAD			02	64	LMSC				
K	1546785		A	TOOLS SPRING COCKING			V		LMSC				
K	1546841			PROTECTIVE COVER			02	64	LMSC				
K	1546933		B	MAST CABLING HARDWARE			08	64	LMSC				
K	1546943			SLING SHROUD HOISTING			02	64	LMSC				
K	1546945			COVER SHROUD PROTECTIVE			02	64	LMSC				
K	1546951			TOOLS SPRING COCKING			03	64	LMSC				
D	1547087		A	CABLE ASSY			V		LMSC				
D	1547248		A	CABLE ASSY COAX			V		LMSC				
K	1547277			RF DATA LINK			01	64	LMSC				
E	1547452			ARRANGEMENT RF DATA LINK			02	64	LMSC				
D	1547574			SPRING LOCKING DEVICE			02	64	LMSC				
K	1547623		D	RF DATA LINK SYSTEM			10	64	LMSC				
E	1547799			COVER PROTECTIVE			04	64	LMSC				
D	1547992			WRENCH SPECIAL			05	64	LMSC				
D	1547993			WRENCH SPECIAL RELEASE			04	64	LMSC				
E	1547994			TOOL SPECIAL TURNBUCKLE			05	64	LMSC				
J	1548256			BLANKET RETRACT SYSTEM			05	64	LMSC				

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SIZE	DRAWING NUMBER	DASH NO.	CHG LTR	TITLE	RESP. DIV.	DWG STAT	RELEASE DATE MO.	RELEASE DATE YR.	VENDOR CODE	USED ON	NEXT ASSEMBLY	OFF COL	SEQUENCE NUMBER
D	1548325			TEMPERATURE SENSOR			04	64	LMSC				
D	1548645			SPRING COCKING DEVICE			05	64	LMSC				
J	1548684			ACTUATOR ASSY			05	64	LMSC				
J	1548818			SLING SAFETY PAYLOAD			07	64	LMSC				
D	1549072			CABLE ASSY RF HELIX			07	64	LMSC				
J	1549081			NITROGEN PRESSURE SYS			07	64	LMSC				
J	1586649			YOKE ASSY HANDLING			11	60	LMSC				
C	1587606			SCREW SPRING COMPRESSOR			10	60	LMSC				
C	1587607			SCREW ASSY SPG COMPRESSR			10	60	LMSC				
J	1587608			PANEL ASSY CONTROL			10	60	LMSC				
J	1587752			RING ASSY HAND YOKE			11	60	LMSC				
J	1587753			BEAM ASSY EXTENDER			00	60	LMSC				
C	1587755			BRACKET ASSY			10	60	LMSC				
C	1587756			LING SLING HAND YOKE			10	60	LMSC				
C	1587757			BRACKET ADAPTER			10	60	LMSC				
C	1587759			SHIM-RING			11	60	LMSC				
C	1587795			RING HANDLING YOKE			10	60	LMSC				
C	1588008			BRACKET CENTER ADAPT			10	60	LMSC				
C	1588050			PIN SLING			11	60	LMSC				
B	1588051			STOP SLING PIN			11	60	LMSC				
C	1588136			SHIM ADAPTER BRACKET			11	60	LMSC				
C	1588137			SHIM-CENTER			11	60	LMSC				
C	1588138			PLATE-STORAGE			11	60	LMSC				
J	1589513		B	SLING ASSY SPOOL PAYLOAD			08	62	LMSC				
J	1591499			SPRING EQUIP NASA			03	61	LMSC				
J	1591502			SPRING COCK ASY NASA			03	61	LMSC				
J	1591503			SPRING LOCK ASY NASA			03	61	LMSC				
C	1600227		D	SWITCH SENSITIVE			01	62	LMSC				
C	1600319		D	SWITCH ENVIRONMENT			02	62	LMSC				
C	1600383		E	RELAY BALANCED ARMATURE			12	61	LMSC				
C	1600639		L	RELAY ARMATURE DPDT			04	64	LMSC				
C	1613071		H	XDUCR VIB PICKUP PIEZO			09	64	LMSC	RA8 B3			
A	1613811			POTENTIOMETER SINGLE			05	60	LMSC				
E	1613849		A	CONNECTOR RECEPT			01	60	LMSC				
C	1613971		J	RELAY ARMATURE DPDT			09	63	LMSC				
A	1614434			SPRING COMPRESSION			07	60	LMSC				
A	1614435			SPRING COMPRESSION			07	60	LMSC				
C	1614779			AMPLIFIER VIB XDUCER			V		LMSC	RA8 B3			
C	1615367		F	ACCELEROMETER LINEAR			07	64	LMSC	RA B3			
C	1618717	•	C	TRANSDUCER PRESSURE			12	63	LMSC	RA B3			
C	1618722		A	CONNECTOR PLUG 503L			11	63	LMSC				
C	1618723		B	CONNECTOR RECEP 503L			11	63	LMSC				
D	1618743		B	AMPLIFIER CHARGE			12	64	LMSC				
C	1620005		A	DUMMY LOAD ELECTRICAL			12	62	LMSC				
D	1620548			FILTER HIGH PASS			02	64	LMSC				

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APPENDIX D

SPACECRAFT/VEHICLE INTERFACE TEST HARDWARE

The following list comprises interface test hardware which was furnished to JPL during the Ranger Program. All of the hardware was placed in storage prior to July 1965.

Item	Identification No.
Agena Forward Equipment Rack	None
Agena Forward Equipment Rack	EM989
Hoist Fixture	LMSC-1586649
Adapter	EM988
Shroud	EM988
Adapter	EM712
Shroud	EM712
Adapter	EM989
Adapter	EM550A
Box Misc. Small Parts (30x30x24)	
Umbilical Plug	1062493
Umbilical Plug	1062493
Umbilical Plug	1063493
Umbilical Plug Cocking Tool	200x-68-730
Umbilical Plug Cocking Tool	200x-68-730
Cable - Match Mate	119347A
Cable - Umbilical (2 ea.) (RA-8 & 9 only)	B3349652
Cable - Umbilical (2 ea.) (RA-8 & 9 only)	B3349653-1
Cable - Umbilical (2 ea.) (RA-8 & 9 only)	B3349653-2
Cable - Umbilical(2 ea.) (RA-8 & 9 only)	B3349653-3

APPENDIX E

LAUNCH-VEHICLE INTEGRATION FILM LIST

1. Ranger 6 Test No. 250 Item 1.2-13V

   Subject: Umbilical Plug Pull-off taken with 1" lens, camera located at top of umbilical tower of Complex 12 ETR - 400 frames/sec.

   An indistinct dark line under the umbilical receptacle door indicates that the door may have been "not latched" as it passed out of view of the camera.

2. Tests at JPL of pulling the umbilical plug and door closure:

   a) Original film - 12" reel
   b) Copy of original film - abridged (400 ft.)
   c) Copy of original film - abridged and partially edited (300 ft)

3. Test at ETR on RA-7 Flight Adapter, taken 6-18-64 128 frames/sec. Indicates umbilical door on RA-7 closes satisfactorily

4. Ranger 7

   a) Test 0448 Item 1.2-13S-4 Dated 7-28-64 Subject: Umbilical Plug Pull-off (printed without timing) taken with 1" lens camera located at top of umbilical tower of Complex 12 ETR 400 frames/sec.
   b) Test 0448 Item 1.2-27u dated - 7-28-64 Subject: Spacecraft Umbilical Plug Pull-off (printed without timing) taken with 4" lens camera located on next to top deck of the umbilical tower of Complex 12. 400 frames/sec.

5. Ranger 8

   a) Test 0235, Item 1.2-10s Dated 2-17-65 Subject: Umbilical Plug Pull-off (printed without timing) taken with 1" lens camera located at the top of the umbilical tower of Complex 12 ETR 400 frames/sec.
   b) Test 0235, Item 1.2-15u Dated 2-17-65 Subject: Spacecraft Umbilical Plug Pull-off (printed without timing) taken with 4" lens camera located on next to the top deck of umbilical tower Complex 12 ETR 400 frames/sec.
   c) Test 0235, Item 1.2-14s, dated 2-17-65 Subject: Boom Retraction (printed without timing)

Ranger 9 Test 0300, Item 1.2-15u, dated 3-21-65

Subject: Spacecraft umbilical plug pull-off (printed without timing) taken with 4" lens camera located on next to the top deck of umbilical tower Complex 12, ETR. 400 frames/sec.

APPENDIX F

LAUNCH-VEHICLE INTEGRATION

INCOMING DOCUMENTS LIST

As of January 1963, all communications coming into the Launch Vehicle Integration Section were entered in the incoming log book. In January 1964, this log was extended to include all documents and drawings as well as communications coming into the Section. Appendix F is the Ranger portion of this log.

RANGER LAUNCH VEHICLE INTEGRATION

1963 INCOMING DOCUMENTS LIST

DATE:	SUBJECT:	REF. NO:	TYPE	CL:	ORIGIN:	LV. NO:
1-10-63	Contract AF 04(647)-592 Agena Weight & Perf. Improvements	A340683/ 91-21	Ltr	U	LMSC	
1-18-63	Vehicle 6006 & 6007 Trajectories & Firing Tables Contract No.AF 04/647/-592	A372084	TWX	U	LMSC	
1-29-63	Ranger Technical Meeting	-	Ltr	U	LeRC/ LMSC	
1-31-63	Ranger Vehicle Performance and Reliability	-	TWX	U	LeRC	
2-13-63	Contract AF 04(647)-592 Status of Hangar Trajectory Effort	A372111	Ltr	U	LMSC	
2-18-63	Ranger/Agena Weight and Performance Improvement	SSVR-81-2-37	TWX	U	SSD	
2-27-63	Action Items Generated at 19th Mtg of Agena Lunar Missions Panel	M-SPA-OSS 2-3	TWX	U	MSFC	
3- 4-63	Terminology for Ranger Launches	-	TWX	U	SSD	
3- 7-63	Design Study of Ranger/ Agena B Adapter	-	Ltr	U	LeRC	
3- 7-63	Ranger/Agena Weight & Performance Improvements	SSVR 7-3-50	TWX	U	SSD	
3-11-63	Status of Study Requests-Ranger Simultaneous Firing Tables, Lowering the Parking Orbits for AMR Missions, Contract No. AF 04/647/-592 & AF 04/695/-59	A374000	TWX	U	LMSC	
3-15-63	Payload Capability Calculations Using Tag Values for Ranger Flights 6, 7, and 8	SSVR 14-3-53	TWX	U	SSD	

DATE	SUBJECT	REF NO	TYPE	CL	ORIGIN	LV NO
3-20-63	Requesting Cost Estimate for Study-Atlas/Agena Perform. Improvement Study (Ranger/Mariner Software Changes)	9410-E.H.D.	Ltr	U	LeRC	
3-20-63	Booster Vehicles for Rangers 6 through 12	9400-3-SCH	TWX	U	LeRC	
3-29-63	Meeting-	SSVR 15-2-38	TWX	SSD	U	
4-12-63	Nineteenth Earth Satellite Performance Panel	9440-4-2 JPS	TWX	U	LeRC	
5-2- 63	Request for Agenda Items NASA Atlas/Agena AMR Guidance Contractors Technical Review Meeting	9321.3-833	TWX	U	STL	
5-20-63	Ranger 8 and 9 Instrumentation Configuration Meeting	SSVZE 17-5-6	TWX	U	SSD	
5-27-63	Submission of New Agenda Items for AMR Guidance Contractors Technical Review Meeting	9321.3-938	TWX	U	STL	
5-21-63	Action Requested of SSD as Result of Study on Atlas Booster Vehicles for NASA Missions, Reliability Improvements	9430-RLP	Ltr	U	LeRC	
5-29-63	Results of Tests on Type V Secondary Battery	63/9128/ 62-23	Ltr	U	LMSC	
6-25-63	Ranger Block III, Contract NAS 3-3800 (AF-04(647)-592	9450-WCA	Ltr	U	LeRC/ LMSC	
7-17-63	Twenty-Second Lunar Performance Panel	9440-7-13 JPS	TWX	U	LeRC	
7-17-63	LV-3A Booster Vehicles	9400-EFB	Ltr	U	LeRC	
7-24-63	Ranger Program-Contract NAS 3-3800 Match-Mate-Dates-Ranger Block III	A376477/ 91-21	Ltr	U	LMSC	

DATE:	SUBJECT:	REF NO:	TYPE:	CL:	ORIGIN:	LV No:
7-26-63	Status of Atlas/Agena Propellant Reserves for Block III Rangers Contract NAS 3-3800	A376498/ 53-72	Ltr	U	LMSC	
7-25-63	Adapter for JPL Test Ranger Block III	9404-7 15-EEH	TWX	U	LeRC	
7-30-63	Ranger Block III Adapter Redesign Contract NAS 3-3800	9410-7- 13-GMB	TWX	U	LeRC	
8-14-63	Ranger III Launch Months	9440-8-3 JPS	TWX	U	LeRC	
8-14-63	Ranger Block III Guidance Equations	9440-8-4- JPS	TWX	U	LeRC	
8-19-63	RJ-1 Influence Coefficients	-	TWX	U	NoAmer	
8-21-63	Project Fire Redirection of Activities to Effectively Utilize the CY 63 Fire Pre-Launch Period	9410-8-19	TWX	U	LeRC	
8-23-63	Contract AF 08(606)5300; Ranger Block III Launch Constrnts Planning Document EPD 130	MTVPS 15990	Ltr	U	PanAm	
8-23-63	Redesign of Instrumentation for Ranger Block III	9410-GMB	Ltr	U	LeRC	
8-27-63	Atlas Booster Configuration for Rangers 10,11, & 12 & EGO-2	9400-8-8- EFB	TWX	U	LeRC	
9- 3-63	Match Mate Tests RA-6	9401-8-35- GMB	TWX	U	LeRC	
9- 4-63	NAS3-3805 Stop Work Order	9409-1-EEH	TWX	U	LeRC	
9- 6-63	The Agena Lunar Performance Panel	9440-9-1- JPS	TWX	U	LcRC	
9- 6-63	Transmittal of T/M Calibration Procedures, Ranger Blk III-Contract NAS 3-3800	A377017 91-20	Ltr	U	LMSC	
9- 9-63	Ranger Block III Azimuth Waiver	9410-9-4 GMB	TWX	U	LeRC	

DATE	SUBJECT	REF.NO.	TYPE	CL:	ORIGIN	LV.NO.
9-11-63	Ranger Program C-Band Beacon Specification	9421-KFR	Ltr	U	LeRC	
9-11-63	Ranger Blk III-Redesign of Instrumentation-Contract NAS 3-3800	A377069/ 91-20	Ltr	U	LMSC	
9-12-63	Ranger 6 Command Destruct System-Contract NAS 3-3800	A377052/ 91-20	TWX	U	LMSC	
9-23-63	Review of the Possiblity of Contamination of Ranger During Agena Retro-Thrust	A377-69	Ltr	U	LMSC	
9-20-63	Contract NAS3-3800-ECP LH-3800-63 Ranger Blk III Destruct Modifications	9404-9- 7-EEH	TWX	U	LeRC	
9-25-63	NAS 3-3800, Amendment No.27	1432	Ltr	U	LeRC	
9-26-63	Revision of Ranger Blk III Systems Test Objectives Document LMSC A057758-B/ dated 9-5-63	-	TWX	U	LMSC	
10- 3-63	Atlas Booster Phase Steering for Block III Rangers Contract NAS 3-3800	A377182	Ltr	U	LMSC	
10- 3-63	Auxiliary Sustainer Cut-Off/ ASCO/Requirement for Block III Ranger as Specified in Program Requirement Docu. No. 1800.	9440-9- 6-KAA	TWC	U	LeRC	
10-3- 63	Ranger Blk III-Redesign of Instrumentation-Contract NAS 3-3800	9410-10- 6-GMB	TWX	U	LeRC	
10- 3-63	General Electric Guidance Retrofit Program	9421-9- 2-PFM	TWX	U	LeRC	
10- 8-63	Request for Agena Antenna	9410-10- 12-GMB	TWX	U	LeRC	
10-11-63	Mod III G Guidance for Ranger 7	9422-10- 1-CRF	TWX		LeRC	
10-15-63	Static Tests for Ranger Block III Adapter	9410-10- 19 GMB	TWX	U	LeRC	

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10-15-63	Booster Steering for RA-6 and 7	9440-10-4-KAF	TWX	U	LeRC	
10-18-63	Ranger Block III Redesign of Instrumentation Contract 3-3800	9410-10-6-GMB	TWX	U	LeRC	
10-22-63	Transmittal of Preliminary Report Task 3 of Contract NAS 3-3805	A377547	Ltr	U	LMSC	
10-21-63	Ranger Block III-Static Tests for Ranger Spacecraft Adapter Contract NAS 3-3800	A377576	TWX	U	LMSC	
10-28-63	Ranger 6 Support	9421-10-2-PFM	TWX	U	LeRC	
10-31-63	Trajectory and Firing Table Publications for Block III Rangers, NAS 3-3800	A377657	Ltr	U	LMSC	
11- 1-63	Conference on Test Results for Ranger Block III	9410-10-33-GMB	TWX	U	LeRC	
11- 4-63	Incorporation of Inspected Diodes in all Atlas Flight Critical Equipments	9400-11-1-CCC	TWX	U	LeRC	
11- 4-63	Ranger 6 Support	9422-9-4-CRF	TWX	U	LeRC	
11- 4-63	S/C Back-Up Timer for Ranger Block III	9422-10-4-RAA	TWX	U	LeRC	
11- 8-63	Information Concerning Command Destruct Receivers for Ranger Block III	9410-11-5-GMB	TWX	U	LeRC	
11-12-63	G.E. Mod III G Guidance Systems for Support of Ranger 6	9400-11-3-SCH	TWX	U	LeRC	
11-12-63	Styrofoam Cooling Sheath-Removal Time, Contract NAS 3-3800.	A602012	Ltr	U	LMSC	
11-15-63	Ranger Block III Contract NAS 3-3800 Spacecraft Adapter Contamination	A602062	Ltr	U	LMSC	

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11-15-63	JPL Request for RF Equipment for Tests on Ranger Block III Program	9421-11 5-RWM	TWX	U	LeRC	
11-15-63	JPL Report No. ST 1.00.20 and Memorandum on Transportation Criteria	9410-11 9-GMB	TWX	U	LeRC	
11-15-63	JPL Request for Temporary Use of a Flight Type FPS-16 Radar Transponder	9421-11 4-RWM	TWX	U	LeRC	
11-25-63	Ranger Block III-Contract NAS 3-3800 Transmittal of Separation Test Results	A-377780	Ltr	U	LMSC	
11-26-63	Ranger Block III, Agena Re-start Timer	A377596/ 91-30	Ltr	U	LMSC	
11-26-63	Ranger Booster Rescheduling	9400-11-4-EFB	TWX	U	LeRC	
11-29-63	Agena Project EMI Test Policy	9421-JLF	Ltr	U	LeRC	
12- 2-63	Guidance Support for NASA/ LeRC Launches	9421-11-	TWX	U	LeRC	
12- 4-63	Data Changes for RA8 and RA9 Targeting	9440-12-1-JPS	TWX	U	LeRC	
12- 5-63	List of Vehicle/Spacecraft Interface Action Items for Ranger Project Block III	9410-GMB	Ltr	U	LeCR	
12- 9-63	Ranger Blk III Drawings	9450:WCA	Ltr	U	LeCR/ LMSC	
12- 9-63	Ranger Blk III Adapter No. 6006	-	Ltr	U	LeRC/ LMSC	
12- 9-63	I. Action Items from the Ninth Meeting of the Ranger Block V Mission Analysis Panel. II. Agenda Items for Next Meeting	Msg 345	TWX	U	Northrop	
12-12-63	Ranger 6008 Matchmate Summary Report	A377670	Rpt.	U	LMSC	
12-13-63	Test Sequence of Events Model 10205 Veh 6008	1342657E	Rpt	U	LMSC	

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12-13-63	Errata to Station View Periods and Trajectory Characteristics for Ranger Block III, EPD 168	-	IOM	U	JPL	
12-13-63	Backup Burroughs Sustainer Cut-Off Requirement for Blk III Ranger	9410-12-21-GMB	TWX	U	LeRC	
12-13-63	Ranger Block III Agena Restart Timer	9410-12-22-GMB	TWX	U	LeRC	
12-16-63	Ranger Block III Documentation - Request	-	Ltr	U	LeRC/ LMSC	
12-16-63	Request for the Temporary Use of a Flight Type C-Band Transponder	9410-GMB	Ltr	U	LeRC	
12-16-63	Plan for Testing NASA/LeRC Soft Mount by GE	9422-12-1-CRP	TWX	U	LeRC	
12-17-63	Backup Burroughs Sustainer Cut-Off Requirements	9410-12 21-GMB	TWX	U	LeRC	
12-17-63	Schedule for RA-8 and RA-9 Matchmate Tests	9410-12-29-GMB	TWX	U	LeRC	
12-17-63	Correction to Letter 9450-WCA D.E. Forney LeRC/LMSC to H.M. Schurmeier Ranger Block III Drawings Dated December 9, 1963	9410-12-33-GMB	TWX	U	LeRC	
12-17-63	Schedule for RA-8 and RA-9 Matchmate Tests	9410-12-29-GMB	TWX	U	LeRC	
12-20-63	Booster Steering for Ranger Block III	9440-KAF	Ltr	U	LeRC	
12-20-63	Ranger 6 Support	9401-12-32-GMB	TWX	U	LeRC	
12-23-63	Booster Steering for Ranger Block III	9440-12-5-KAF	TWX	U	LeRC	
12-27-63	Excess Payload Distribution for Rangers RA-8 and RA-9	A602506	TWX	U	LMSC	
12-30-63	Agena/RA-6 Daily Activity Report No. 1	Msg 001	TWX	U	JPL/ETR	00001
12-31-63	Agena/RA-6 Daily Activity Report No. 3	Msg 001	TWX	U	JPL/ETR	00003

RANGER LAUNCH VEHICLE INTEGRATION

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1-6-64	Agena/RA-6 Daily Activity Report No. 1	Msg. No. 001 12-27-63	TWX	U	JPL/AMR	00001
1-6-64	Agena/RA-6 Daily Activity Report No. 2	Daily Rpt. 12-30-63	TWX	U	JPL/AMR	00002
1-6-64	Agena/RA-6 Daily Activity Report No. 3	Daily Rpt. 12-31-63	TWX	U	JPL/AMR	00003
1-6-64	Spacecraft Adapter for JPL Testing	LMSC/ A377820 12-31-63	Ltr	U	LMSC	00004
1-6-64	Agena/RA-6 Daily Activity Report No. 4	Daily Rpt. 1-2-64	TWX	U	JPL/AMR	00005
1-6-64	Agena/RA-6 Daily Activity Report No. 5	Daily Rpt. 1-3-64	TWX	U	JPL/AMR	00006
1-6-64	Agena/RA-6 Daily Activity Report No. 6	Daily Rpt. 1-6-64	TWX	U	JPL/AMR	00007
1-6-64	Minutes of 24th Mtg.-agena Lunar Missions Panel, held at LeRC 11-14-63		DOC	U	JPL/AMR	00008
1-6-64	JPL Request for Change in Telemetry Measurements	9410-1-3 GMB 1-6-64	TWX	U	LeRC	00009
1-7-64	Instrumentation and Telemetry for Vehicle 6006 & 6007	9421-KFR 1-3-64	Ltr	U	LeRC	00012
1-7-64	Ranger Blk III Documentation Request	LMSC/ A602539 91-13 1-2-64	Ltr	U	LMSC	00013
1-7-64	Agena/RA-6 Daily Activity Report No. 7	RA-6 Daily Rpt.	TWX	U	JPL/AMR	00014
1-7-64	Revised JPL Spec. for OSE Equip. AMR Launch Complex	00017 1-8-64	Ltec	U	JPL/AMR	00017
1-7-64	Request fa clg. in telem. meas. for RA-8 & 9.	00019 1-8-64	TWX	U	JPL	00019

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1-7-64	Spacecraft adapter contamination	00020 1-9-64	Ltr	U	JPL	00020
1-7-64	Inspection and Test of Non-Flight Allocated Hardware	9460:WCA 1-7-64	Ltr	U	LeRC/ LMSC	00021
1-8-64	Agena/RA-6 Daily Activity Report No. 8	RA-6 Daily Rpt.	TWX	U	JPL/AMR	00024
1-9-64	Standard For Welded Module Wiring	MSFC Spec IOM 01618	Trans	U	MSFC	00025
1-9-64	Specification for Non-Structural Resistance Spot Welding	MSFC Spec IOM 01617	Trans	U	MSFC	00026
1-9-64	Agena/RA-6 Daily Activity Report No. 9	RA-6 Daily Rpt.	TWX	U	JPL/AMR	00028
1-9-64	Revision of Ranger Blk III Sys Test Objective Doc.	LMSC/ A602630 TWX 189	TWX	U	LMSC	00029
1-9-64	JPL Request for Data	9410-1-7-GMB	TWX	U	LeRC	00030
1-10-64	Report on Ranger 6 Vehicle Procurement Major Project Milestones	9430-RLP 1-7-64	Ltr	U	LeRC	00031
1-9-64	The Agena Earth Satellite Performance Panel	9440-1-5 JPL 1-9-64	TWX	U	LeRC	00032
1-10-64	Agena/RA-6 Daily Activity Report No. 10	RA-6 Daily Rpt.	TWX	U	JPL/AMR	00033
1-10-64	Booster Steering for Ranger BLK III	9440-1-6-EHD 1-10-64	TWX	U	LeRC	00034
1-13-64	Ranger 6 Launch Vehicle Sys Success Analysis	NASA/ LeRC Exh. A 9-23-63	Stat of Work	U	LeRC	00036
	Launch Vehicle (LV-3A) Flt Test Plan for No. 199D at AMR		Ltr/ Doc	U	GDA	00037
1-14-64	Ranger 6 Weight and Performance Status	9410-1-13-EHD 1-13-64	TWX	U	LeRC	00040

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1-14-64	Revision 4 to BR 4901 (SLV-III-01-01A)	314-7(JPL) 1-13-64	Memo	U	AMR/JPL	00041
1-15-64	NASA Flight Schedules	Flt Sched. 12-31-63	Sched		NASA Hq	00042
1-15-64	Atlas/Agena Performance Improvement Study for Ranger/Mariner & EGO	LMSC/A377 860 TWX207 1-13-64	TWX	U	LMSC	00043
1-15-64	Security Classification of Agena Tracking Data (Ref. 00075)	LMSC/ A602582 1-3-63	Ltr	U	LMSC	00044
1-15-64	JPL Specification RC-30947-DTL-C	9410-GMB 1-14-64	Ltr	U	LeRC	00048
1-15-64	Ranger Blk III Launch Constraints Planning Document EPD-130	9401-GMB 1-14-64	Ltr	U	LeRC	00049
1-15-64	Agena/RA-6 Daily Activity Report No. 11	RA-6 Daily RPT	Memo	U	JPL/AMR	00050
1-15-64	RA-6 Daily Activity Report from JPL/AMR	RA-6 Daily Rpt. #12	TWX	U	JPL/AMR	00051
1-15-64	RA-6 Daily Activity Report from JPL/AMR	RA-6 Daily Rpt. #13	TWX	U	JPL/AMR	00052
1-16-64	RA-6 Daily Activity Report from JPL/AMR	RA-6 Daily Rpt. #14	TWX	U	JPL/AMR	00053
1-16-64	Vehicle Reg. Restraints Docs. for RA-Block III Missions	9410-GMB 1-10-64	Ltr	U	LeRC	00054
1-16-64	Shipment of Type V. Transponder to JPL	LMSC TWX 38 1-16-64	TWX	U	LMSC	00060
1-17-64	RA-6 Daily Activity Report from JPL/AMR	RA-6 Daily Rpt. #15	TWX	U	JPL/AMR	00063
1-17-64	AMR-PRD #1800 Revision of Ranger Blk III	PRD 1800 Rngr Rev. 4	Memo		JPL/AMR	00064
1-17-64	Weight and Performance Status Report	LMSC376330-6,LMSC/A 602547-91-20	Doc/ Ltr	U	LMSC	00065

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1-17-64	Contract Change Notice-CCN#52, NASA3800	9404-1-17-JRE 1-17-64	TWX	U	LeRC	00066
1-17-64	Revision to PRD 1800 RA Blk III	9410-1-24-GMB 1-17-64	TWX		LeRC	00067
1-20-64	RA-Blk III Separation Sys Performance	94AA-RNR	Ltr	U	LeRC	00070
1-20-64	Spec. Match Mate of RA S/C & Nose Cone to Support Structure-JPL	LMSC414559C 1-15-64	Spec	U	LMSC	00074
1-20-64	Use of Kaula Spheroid for Blk III Post Flt Data Analysis	9410-1-25-GMB 1-20-64	TWX	U	LeRC	00075
1-20-64	RA-6 Daily Activity Report from JPL/AMR	RA-6 Daily Rpt. #16	TWX	U	JPL/AMR	00076
1-21-64	RA-6 Daily Activity Report from JPL/AMR	RA-6 Daily Rpt. #17	TWX	U	JPL/AMR	00077
1-21-64	Certification of Agena Command Destruct Components RA Blk III	LMSC/A602 727-91-20 1-17-64	TWX	U	LMSC	00078
1-20-64	S/C Vibrometer Proposal, RA-8 and 9	9460:WCA 1-20-64	Ltr	U	LeRC/ LMSC	00079
1-21-64	Shipment of Type V Transponder to JPL	9410-1-29 GMB 1-21-64	TWX	U	LeRC	00081
1-21-64	Shipment of Type V Transponder to JPL	9410-1-28 GMB 1-21-64	TWX	U	LeRC	00082
1-16-64	Transmittal of Static Test Data, S/C Adapter	LMSC/A 377873	Ltr	U	LMSC	00083
1-21-64	Minutes Meeting-Interface Dwg Review	IOM 1-15-64 Mts 1-15-64	Ltr	U	LMSC	00084
1-21-64	LMSC A-610655, Transmittal of S/C adapter & Qualification Test	LMSC/A377 872 1-15-64	Ltr	U	LMSC	00085
1-21-64	Proposed Revision of RA Blk III Systems Test Objectives LMSC/A057758B	9410-27-GMB 1-21-64	TWX	U	LeRC	00086
1-22-64	LMSC-A377651, 12-1-63 Dates of RA-Bl V Launch Veh Payload Capability	LMSC/A377 809	Ltr/Doc	U	LMSC	00088
1-22-64	RA-6 Daily Activity Rpt from JPL/AMR	RA-6 Daily Rpt.#18	TWX	U	JPL/ AMR	00090
1-22-64	Addendum of Additions to LMSC/A377927 Subsys A, Eng. Analysis Rpt	LMSC/A6022 63/D91-12 1-19-64	Ltr/ Doc	U	LMSC	00091
1-22-64	Status Report, NASA Peculiar Studies Dec 1963	LMSC/A377 869/D91-12	Ltr	U	LMSC	00092
1-23-64	Ranger VI, Master Launch Countdown	LMSC Proc AMR 133099	Doc	U	JPL/ AMR	00093
1-23-64	Certification of Agena Command Destruct Components	LMSC/A602 744-91-20 1-22-64	TWX	U	LMSC	00094
1-23-64	Separation Instrumentation for RA-8 & 9	LMSC/A3788 86 1-22-64	TWX	U	LMSC	00098
1-23-64	RA-6 Daily Activity Report Addendum #18	RA-6 Rpt#18 Add. 1-23-64	TWX	U	JPL/ AMR	00099
1-23-64	RA-6 Daily Activity Report Addendum #19	RA-6 Rpt#19 1-23-64	TWX	U	JPL/ AMR	00100
1-23-64	RA-6 Post Flt Critique Analysis Mtg JPL 2-7-64	9450-1-15 ALG	TWX	U	LeRC	00103
1-23-64	Proposed Base Band Coupler Spec. Change, NAS3-3800 Request for Action #58	LMSC/A377 887	TWX	U	LMSC	00105
1-24-64	Fixed Price Quotation VHF Tele Ant. C Band Beacon Ant. Cable & Sept. Asy	TWX 148 S/V/LMSC	TWX	U	LMSC	00106
1-24-64	Progress Report for NASA Agena-3copies Classified	Mthly Prog. Rpt Agena Proj. 12/63	Doc	U	LeRC	00111
1-24-64	Medium Space Vehicles Program, Mthly Prog Rpt Dec '64 SP 64-03 LMSC-447186 -42 dated 1-20-64	LMSC/A6022 70/D91-12	Ltr/ Doc		LMSC	00112
1-24-64	Agena/RA-6 Daily Activity Report	RA-6 Daily Rpt	TWX	U	JPL/AMR	00113

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1-24-64	Transmittal of Base Band Coupler IDC Action Item #58	LMSC A377 888 1-20-64	Ltr	U	LMSC	00115
1-27-64	Final Launch Criteria RA-6 Revision to Sys Test Obj.	LMSC/A602 751 1-20-64	TWX	U	LMSC	00118
1-27-64	Match Mate Dates & Dummy Run for RA-8 & 9	9410-GMB 1-24-64	Ltr	U	LeRC	00120
1-27-64	Electromagnetic Interference Control Requirements and Electrical Interface for Agena Systems	4479690B 8-1-62	Doc	U	LMSC	00121
1-27-64	RA-6 Daily Activity Report No. 21	RA-6 Daily Rpt 1-27-64	TWX	U	JPL/ AMR	00122
1-27-64	Ranger Blk III Instantaneous Impact Points for the Arm-Engine-cut Off Event	LMSC/A602 712 1-17-64	Ltr		LMSC	00123
1-27-64	Proposed Base Band Coupler Specification Change (Action Item #58)	9410-1-31-GMB 1-27-64	TWX	U	LeRC	00126
1-27-64	20 Copies of Improved Re-production of page 3w/ expl.	MSFC-STD 349 pg 3 11-15-63	pg 3 MSFC STD-379	U	MSFC	00127
1-28-64	Chg. Tele. Measurements Ch. 18, RA 8 & 9 Action Item#48	14329ESKI-Contracts) 1-23-64	Ltr	U	LeRC	00128
1-28-64	Confirmation of Launch Criteria Agena Vehicle	LMSC/A602 818 1-27-64	TWX		LMSC	00132
1-28-64	25th Lunar Performance Panel	9440-1-19 JPS 1-27-64	TWX	U	LeRC	00133
1-28-64	Agena/RA-6 Daily Activity Rpt #22	RA-6 Daily Rpt 1-27-64	TWX	U	JPL/ AMR	00134
1-28-64	Additional Launch Criteria Applicable to Ranger 6008 Flight	LMSC/A602 824-91-30 1-28-64	TWX	U	LMSC	00139
1-28-64	Product Assurance Report, Pre-Flight Failure Discrepancy Analysis (2cpy)	LMSC/A048 135-16 1-64	Doc	U	LMSC	00140

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1-29-64	Agena/RA-6 Daily Activity Report No. 23	RA-6 Daily Rpt 1-28-64	TWX	U	JPL/ AMR	00141
1-29-64	Change in Back-up Timer Brackets for Ranger Blk III Flights 6 & 7	9404-1-19 JRE 1-29 64	TWX	U	LeRC	00142
1-27-64	Boosters, Steering Manual Constant Setting for RA-6	169-179 1-21-64	TWX	U	LMSC	00143
1-29-64	Test Adapter 6006-Ranger Block III	9460:WCA 1-28-64	Ltr	U	LeRC/ FEB	00144
1-29-64	Prog. Req. Revision Control Sheet LMSC/A602647 1-10-64	LMSC/A602 274/D91-30 1-28-64	Ltr/ Doc	U	LMSC	00149
1-31-64	Still Photo Report for January Two Sets 8-1/2" x 11" w/captions	LMSC/A06 6699,D/62-85,B526 1-28-64	Ltr/ Photos	U	LMSC	00152
1-31-64	Two copies ea. of revised pages to flt termination sys report Ranger 6-9 EOGO 6501-6502	LMSC/A602 273-095-0	Ltr/ Rev.	U	LMSC	00153
1-1-64	Request for Documents	9406-WCA 1-29-64	Ltr	U	LeRC	00156
2-3-64	Final NASA Vehicle 6008 (U) Calibration Rpts	LMSC/657 744	Doc	U	LMSC	00159
2-3-64	Atlas/Agena Working Grp Launch Test Directive, Ranger Blk III	LMSC 271 739-A 1-24-64	Doc	U	LMSC	00165
2-3-64	Atlas/Agena Working Grp Launch Test Directive, Ranger Blk III	LMSC 271 739-B 1-29-64	Doc	U	LMSC	00166
2-3-64	Agena/RA-7 Daily Activity Report No. 1	RA-7 Daily Rpt 2-3-64	TWX	U	JPL/ AMR	00167
2-4-64	Agena/RA-7 Daily Activity Report No. 2	RA-7 Daily Rpt 2-4-64	TWX	U	JPL/ AMR	00169
2-4-64	Summary Report of Structural Dynamics & Load Data for Ranger Vehicles 6001-6005	LMSC/A77 898 LMSC/ A384258 1-28-63	Ltr/ Doc	U	LMSC	00171
2-5-64	Agena/RA-7 Daily Activity Report No. 2	RA-7 Daily Rpt 2-5-64	TWX	U	JPL/ AMR	00176

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2-5-64	Ranger 6 Pre-Flight Weight & Performance Studies	LMSC/A377 910 2-3-64	TWX	U	LMSC	00178
2-5-64	Safe Systems Operation Group Concept	LMSC/A377 832 1-2-64	Ltr	U	LMSC	00179
2-6-64	Revision 5 & 6 to PRD 1800	IOM 314R-17		U	JPL	00181
2-6-64	Weight & Performance Status Report NASA Agena Satellite & Probe Missions	LMSC/A376 330-7 2-1-64	Doc	U	LMSC	00182
2-6-64	Vehicle Functional Schematics 6006-07	Dwg 1342542 12-17-63	Doc	U	LMSC	00183
2-6-64	Agena/RA-7 Daily Activity Report No. 4	RA-7 Daily Rpt 2-6-64	TWX	U	JPL/ AMR	00184
2-6-64	Spacecraft Dummy Runs for Rangers 8 & 9 Action Item #49	9410-2-3 GMB 2-6-64	TWX	U	LeRC	00185
2-7-64	Request for Clearance	SYHW A12 2-5-64	TWX	U	G.E.	00186
2-7-64	Agena/RA-7 Daily Activity Report No. 5	RA-7 Daily Rpt 2-7-64	TWX	U	JPL/ AMR	00190
2-7-64	AE62-0520-250 Dated 8-10-62. Atlas Flt Test Plan, Booster No. 250D (cpy)	Emp:rt 523-1386 2-6-64	Ltr/ Doc	U	GD/A	00191
2-7-64	AE62-0520-204 Dated 12-26-63, LV-3A 204D Flt Test Plan & Instra. Smry	Emp:bal 523-1393 2-5-64	Ltr/ Doc	U	GD/A	00192
2-7-64	Vellum Copies of 5 Dwgs. 1308303, 1354546, 1600227, 1600319	Shoenhair 91-01 517 2-7-64	Pkg	U	LMSC	00199
2-10-64	Agena/RA-7 Daily Activity Report No. 6	RA-7 Daily Rpt 2-10-64	TWX	U	JPL/ AMR	00203
2-11-64	LeRC shaped vibration spectrum for Atlas Guidance soft mount	9422-2-CRF 2-11-64	TWX	U	NASA/ LeRC	00205
2-11-64	Spacecraft Vibrometer Proposal, Ranger Blk III	LMSC/A602 840 2-7-64	TWX	U	LMSC	00207
2-11-64	Agena/RA-7 Daily Activity Report No. 7	RA-7 Daily Rpt 2-11-64	TWX	U	JPL/ AMR	00208
2-11-64	Booster Steering for Ranger Blk III	9440-2-3 KAF 2-11-64	TWX	U	LeRC	00209
2-12-64	Agena/RA-7 Daily Activity Report No. 8	RA-7 Daily Rpt. 2-12-64	TWX	U	JPL/ AMR	00216
2-13-64	Agena/RA-7 Daily Activity Report No. 9	RA-7 Daily Rpt 2-13-64	TWX	U	JPL/ AMR	00217
2-14-64	Ranger Blk III Action Items LV/SC Interface Status	9410-GMB 2-12-64	Ltr	U	LeRC	00219
2-14-64	JPL Request for LMSC Document	9410-GTH 2-11-64	Ltr	U	LeRC	00223
2-14-64	JPL Request for GD/A Document	9410-GTH 2-11-64	Ltr	U	LeRC	00224
2-14-64	Transmittal of LMSC Documents (Ref:00183 & 00199)	LMSC/A602 881 2-5-64	Ltr	U	LMSC	00226
2-14-64	Agena/Spacecraft Matchmate Dates for S/C Dummy Runs RA-8 & 9	LMSC/A377 922 2-10-64	Ltr	U	LMSC	00227
2-14-64	Guidance Equations for RA-7	STL/9321.3-1166 2-5-64	Ltr		STL	00228
2-17-64	NASA Peculiar Studies Status Report	LMSC/A602 285/D95-30 2-17-64	Ltr/ Doc	U	LMSC	00229
2-17-64	Request for Documentation	9402-WFK 2-13-64	Ltr	U	LeRC/ SSD	00230
2-17-64	Final NASA Vehicle 6009 Calibration Report RA-7	9460-DEF 2-14-64	Ltr/ Doc	U	LeRC/ LMSC	00232
2-11-64	LeRC Shaped Vibration Spectrum for Atlas Guidance Soft Mount	9422-2-CRF 2-11-64	TWX		LeRC	00205
2-17-64	Agena/RA-7 Daily Activity Report No. 10	RA-7 Daily Rpt	TWX	U	JPL/ AMR	00233
2-17-64	Atlas/Agena B Error Source Definitions for Ranger Units of Variance (21 cpys)	LMSC/A602 652 2-6-64	Doc	U	LMSC	00236

DATE:	SUBJECT:	REF NO:	TYPE:	CL:	ORIGIN:	LV NO:
2-18-64	Preliminary Spacecraft Operations Letter Ranger VI Reorder No. 64-41	JPL Reorder 63-41 2-10-64	Doc.	U	JPL/ SFOC	00237
2-19-64	Revisions to PRD 1800	9410-GMB 2-14-64	Ltr		LeRC	00242
2-19-64	Detail Specification for the SS-01A Vehicle dated 8 May 1964 Maintenance of LMSC Spec 1414554A	SSVAC/D.D. Phillips 2-18-64	Ltr/ Doc	U	AFSSD	00243
2-19-64	Transmittal of Doc-LMSC Spec C-Band Radar Type Type V Transponder	9460-WCA 2-18-64	Ltr/ Doc	U	LeRC/ LMSC	00244
2-20-64	Transmittal of Documents, Contract NAS3-3800	LMSC/A602 948-91-20 2-18-64	Ltr	U	LMSC	00250
2-21-64	Mthy Prog Report, Month of Jan. 1964 by Agena Proj.	Agena Mthly' Prog. Rpt 2-7-64	Doc		LeRC	00255
2-24-64	LMSC/A060673-B 2-5-64 Report Change Record for Flight Term. Sys Ranger	LMSC/A602 286/095-30 2-12-64	Ltr	U	LMSC	00260
2-24-64	LMSC-B040418 XA3938 Ranger 6 Launch Rpt AMR Range Test 2-19-64	LMSC-273 053 2-19-64	Doc	U	LMSC	00264
2-24-64	LMSC-447186-43 Medium Space Vehicles Programs SP-64-10 Monthly Prog. Report Jan 1964	LMSC-A602 291/D95-30 2-17-64	Ltr		LMSC	00265
2-27-64	Change in Telemetry Measurement for Ranger Flights 8 & 9	9410-2-20-GMB 2-20-64	TWX	U	LeRC	00266
2-24-64	RA-6 Data Presentation Meeting TWX244	A377954 2-22-64	TWX	U	LMSC	00268
2-26-64	TWX 183, RA-6 Data Present Meeting	LMSC/A377 954 2-21-64	TWX	U	LMSC	00271
2-26-64	Launch Schedule	9409-2-13 ES 2-26-64	TWX		LeRC	00273
2-27-64	LMSC/A048135-17 Product Assurance Rpt (Pre-Flight)	LMSC/A602 289/D95-30 2-14-64	Doc	U	LMSC	00276

DATE:	SUBJECT:	REF NO:	TYPE:	CL:	ORIGIN:	LV NO:
2-27-64	LMSC Preferred Parts Handbook Sup. 1 Vehicle Sup. 3 AGE	sent w/o transm	Doc	U	LMSC	00277
2-27-64	LMSC Spec 1210919 F w/ Status Sheets	9460-WCA 2-26-64	Doc	U	LeRC/ LMSC	00278
2-27-64	LeRC/LMSC Ltr to LMSC Transmtl of JPL Dwgs Action Item #62	9460:WCA 2-20-64	Ltr	U	LeRC/ LMSC	00280
2 -27-64	SSVAC/F.O. Phillips, Maintenance of LMSC Spec. 1414554A	SSVAC/F.O. Phillips 2-25-64	Ltr	U	AFSSD	00281
2-28-64	Still Photo Rpt for Feb. Ranger	LMSC/A634 779 D-62 B526 2-25-64	Ltr	U	LMSC	00283
2-28-64	63K210, PRD, Launch Vehicle Guidance Sys 11-15-63	Direct Mail Ans to TWX	Doc		GE/B	00284
2-28-64	Pages 1 & 3 of LMSC/ A374543-8 and pages 1 & 9 of LMSC A088866-18	LMSC/A602 962-91-40 2-14-64	Ltr		LMSC	00286
2-27-64	LMSC Specs: FC-060102A FCP-C60104, FCP-060102A FCP-C60106	Hand-Carr. by Lane	Doc	U	LMSC	00288
3-2-64	Ltr LeRC to LMSC, 9410GMB Security Classif. of Agena Tracking Data	9410-GMB 2-12-64	Ltr	U	LeRC	00292
3-2-64	TWX 98, Booster Steering for Ranger 7	LMSC/A377 958 2-27-64	TWX	U	LMSC	00293
3-3-64	LMSC 658747, Vol. I Cape Kennedy, Vol. III TMS Yankee Quick Look Rpt	LMSC/A603216 2-21-64	Ltr/ Doc		LMSC	00298
3-3-64	Trajectory Generation Effort for Ranger Blk III	LMSC/A603 233 2-28-64	TWX	U	LMSC	00300
3-3-64	LMSC Transmittal of Dwgs to JPL an microfilm Ranger Action Item #53	9410-GTH 4-2-64	Ltr	U	LeRC	00301
3-3-64	Ranger 6 Flight Analysis Data	LMSC/A377 967 2-28-64	TWX	U	LMSC	00302

DATE:	SUBJECT	REF NO:	TYPE:	CL:	ORIGIN:	LV NO:
3-4-64	RA-6 Data Presenting Mtg See LV-00271	9410-3-5GMB 3-4-64	TWX	U	LeRC	00304
3-5-64	LMSC Dwgs D1352961, E01352941-NC-1 D1354943	Govt Form 10 3-3-64	Memo	U	LeRC/ LMSC	00305
3-5-64	Spring Rates of RA-8 Space-craft Action Item #64	9410-3- GMB 3-4-64	TWX	U	LeRC	00309
3-5-64	Ma C & Ranger on Pad Cooling	LeRC9410-3-1 RTG 3-4-64	TWX	U	LeRC	00310
3-5-64	JPL Request for Instru-mentation Change for RA-7 RA-8 & RA-9 Flights	9410-3-7- GMB 3-5-64	TWX	U	LeRC	00311
3-11-64	JPL Launch Vehicle/Space-craft Interface Schedule	LMSC/A603 321-91-11	Ltr	U	LMSC	00323
3-11-64	Sys Test Objectives-Revised Pages LM-SC/A057758-B	LMSC/A602 301-95-30	Ltr	U	LMSC	00324
3-12-64	Proposed Base Band Coupler Spec. Chg.	9410-3-19 GMB 3-12-64	TWX	U	LeRC	00327
2-12-64	JPL Request for LMSC Drawings	9410-3-18- GMB 3-12-64	TWX	U	LeRC	00328
3-16-64	On Pad Cooling for Ranger Blk III Spacecraft	9422-JHM 4-12-64	Ltr	U	LeRC	00335
3-16-64	Styrofoam Cooling Sheath Flash Rpt FL-7932-G	LMSC/A603 343-91- 20 4-12-64	Ltr	U	LMSC	00336
3-16-64	Transmittal of Antenna Pattern	9460 WCA 4-12-64	Ltr	U	LeRC/ LMSC	00338
3-17-64	Echo A-12, Launch Rpt SLV-2/S-01/397/6301	LMSC 226 417 from CD 3-17-64	Doc		LMSC/ SSD	00341
3-17-64	Flight Evaluation and Performance Analysis Rpt for A-12 Mission	SP-64-14, LMSC A603 211 4-10-64	Doc		LMSC	00342
3-17-64	NASA/LeRC Vehicle Re-affirmation Schedule, March 11, 1964	Issue #4 3-11-64	Dist.		LeRC	00343
3-17-64	NASA Agena Vehicle Film Rpt #6 One Release Print	LMSC/153 037 3-11-64	Film	U	LMSC	00345
3-17-64	NASA Peculiar Studies Status Report	LMSC/A602 306-95-30 3-11-64	Ltr	U	LMSC	00346
3-17-64	Wt & Performance Status Report	A376330-8 3-1-64	Rpt	U	LMSC	00347
3-18-64	Spring Rates for RA-8 Spacecraft Legs	9410-3-31 GMB 3-18-64	TWX	U	LeRC	00352
3-18-64	Review of JPL Drawings J-3159347A & J3180151A	LMSC/A377 992 3-12-64	Ltr	U	LMSC	00353
3-11-64	Antenna Patterns		Ltr		GE	00358
3-26-64	LMSC Document A049509-Being Revised	LMSC/A603 357 3-11-64	Ltr	U	LMSC	00370
3-26-64	Monthly Progress Report, Feb. 1964, by Agena Project	Agena Proj. Rpt 2-'64	Doc		LeRC	00371
3-26-64	Ranger 6 Agena Umbilical Investigation	9421-PRM 3-18-64	Ltr	U	LeRC	00372
3-26-64	Ranger and Mariner C Spacecraft Wts.	LMSC/A603 000 3-20-64	Ltr	U	LMSC	00373
3-26-64	Medium Space Vehicles Pro-grams, Monthly Progress Report, Feb. 1964	LMSC/A603 405-95-10- 3-16-64	Ltr/ Doc		LMSC	00374
3-26-64	Agena Launch History Summaries Transmittal	LMSC/A603 341-91-40 3-10-64	Ltr		LMSC	00376
3-30-64	The Agena Lunar Perfor-mance Panel	W00010-MSW 101Ma069HQ e050 3-27-64	TWX	U	LeRC	00381
3-30-64	JPL Request for Instrumen-tation Change for RA 8 and RA 9 Flights Action Item #60	9410-3-44A GMB 3-30-64	TWX	U	LeRC	00388
3-31-64	Instrumentation Change for RA7, RA-8, and RA-9 Flights	9410-3-44 GMB 3-30-64	TWX	U	LeRC	00389

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3-3-64	RA-6 Agena Vehicle 6008 Flt. Evaluation & Perform. Analysis Rpt.	LMSC/A603 322 3-25-64	Doc		LMSC	00402
3-30-64	Atlas Space Launch Vehicle Flight Test Evaluation	GD/A/BKF 64-002 3-30-64	Doc	S	GD/A	00404
4-1-64	Launch Vehicle Status for RA-8	9410-GMB 4-1-64	Ltr	U	LeRC	00407
3-31-64	Ranger 6 Telemetry Step Force Data	LMSC/A377 981 3-31-64	Ltr	U	LMSC	00408
4-3-64	Repeat Test of RA-8/Adapter 6006 to determine Spring Rate Constants	9410-4-4-GMB	TWX	U	LeRC	00409
4-7-64	Interface Action Items-Reply to JPL 90111	9410-GMB 4-1-64	Ltr	U	LeRC	00412
4-9-64	RPD1800, Revision 7	LMSC/A603 500-61-48 4-7-64	Ltr		LMSC	00417
4-9-64	Still Photo Report for March	LMSC/A639 505 D62-85 3-27-64	Ltr	U	LMSC	00419
4-9-64	Rev. Pgs RA-6 Agena Veh. 6008 Flt. Eval. & Perf. Report	LMSC/A603 322	Doc	C	LMSC	00420
4-9-64	Agena Program Management Plan	22-89-830-493 3-18-64	Doc	C	NASA	00422
4-9-64	NAS3-3800 - Launch Schedule	1432-EFS 3-13-64	Ltr	C	NASA	00423
4-9-64	Transmtl. of LeRC Analysis of a Proposed Separation Monitoring Circuit	4421-KFR	Ltr	U	NASA	00428
4-13-64	Documentation Request - Range Block III	WCA 4-7-64	Ltr	U	LeRC/ LMSC	00437
4-13-64	Ranger 6 Telemetry Step Force Data	9460-WCA 4-8-64	Ltr	U	LeRC/ LMSC	00438
4-14-64	Review of March 6, 1964 Revisions to LMSC A057758-B System Test Objectives for Ranger Project Flts. RA-6 and RA-9	9410-GMB 4-9-64	Ltr	U	LeRC	00442
4-14-64	Twenty Sixth Lunar Performance Panel	9440-4-7-JPS 4-13-64	TWX	U	LeRC	00443
4-15-64	Transmittal of Interface Drawings	LMSC/A603 048 4-10-64	Ltr	U	LMSC	00454
4-17-64	JPL Request for LMSC Dwgs. 139-6010, 139-7133, 139-7134, 146-1970, 139-7131	LMSC/A603 533 4-7-64	Ltr	U	LMSC	00464
4-22-64	LeRC Agena Monthly Progress Rpt.	3-64	Doc	C	LeRC	00473
4-23-64	Pages 1 & 3 of Agena Flight History Summary	A374543 4-1-64	2 pgs	C	LMSC	00485
4-23-64	Pages 1 & 11 Countdown Termination Summary	A088866-20 4-1-64	2 pgs	C	LMSC	00486
4-23-64	Revised Targeting for Ranger Launch Period 8	LMSC/A603 059 4-21-64	TWX	U	LMSC	00487
4-24-64	Two Decals - Elec 1024910-9	4-23-64	Ltr	U	LeRC/ LMSC	00492
4-27-64	Ranger Vehicle 6009 (Schedule & Test Veh. 6009)	9410-4-24 GMB 4-24-64	TWX	U	LeRC	00497
4-30-64	Program Management Plan	03-00 4-15-64	Doc	C	NASA Hq	00508
4-30-64	Official NASA Flight Schedule	4-14-64	Doc	C	NASA Hq	00510
5-1-64	Amendment to G.E. Test Plan for NASA/LeRC Soft Mount	9422-4-1 CRF 4-30-64	TWX	U	LeRC	00512
5-1-64	Combined Change No.'s 4 &5	1414554A	Rev	U	LMSC	00513
5-1-64	Attached Dwgs. LMSC 1613971, 1600639, 1335595, 1349075 Information on Relays per LMSC Dwgs. Schematic 1342452	4-30-64	U.S. Memo	U	LeRC/ LMSC	00514
5-1-64	Eval. Red't Mod III Guidance 199D/6009 RA-6	640200 4-1-64	Doc	S	G.E.	00516
5-5-64	LMSC-A057758, 24 April 1964, Rpt. Change Record for STO	LMSC/A603 741 4-27-64	Ltr	U	LMSC	00519

DATE:	SUBJECT:	REF NO:	TYPE:	CL:	ORIGIN:	LV NO:
5-7-64	LMSC/A602502-Rev. B, Dated 3-10-64 for Agena B Vehicles Launch & Hold Limitations	LMSC/A603 674(95-10) 4-29-64	Ltr	U	LMSC	00535
5-8-64	Weight and Performance Status Rpt.	LMSC SP-38XX-64-1-Rev 1 5-1-64	Doc	U	LMSC	00541
5-12-64	Launch Schedule (NAS3-3800	9404-5-8-RE 5-11-64	TWX	C	LeRC	00550
5-12-64	Addendum to Subsystem A-Eng. Anal. Rpt. - Agena B	A377427-1	Rev	C	LMSC	00554
5-1-64	Program Management Plan for 4-29-64	22-89-830-493 4-29-64	Plan	C	NASA	00555
5-12-64	Program Op'n Sched. Ranger PRD 1800	4-6-64	Rev	C	AFMTC	00557
5-13-64	Ranger B Launch Plans: Mod to	PR 112052	TWX	C	NASA Hq	00566
5-15-64	Contract NAS3-3800, Amendment No. 87	1432-JRE 5-15-64	Ltr	U	LeRC	00574
5-1-64	Agena Component Electrical Testing JPL Relay Info	9410-5-18 GMB 5-15-64	TWX	U	LeRC	00585
5-20-64	Documentation Request-Ranger Block III 44 days	LMSC/A6038-66-95-10	Ltr	U	LMSC	00596
5-30-64	Ltr. of Transmittal Re. 44 Dwgs.	A603866 5-18-64	Ltr.	U	LMSC	00600
5-21	Study of Horizon Cloud Cover Criteria for Agena Launches	LMSC/A6031-04 5-19-64	Ltr	U	LMSC	00603
5-25-64	NAS3-3800, Amendment No. 89 RA-7 Launches Schedule	NAS3-3800	Ltr.	C	LeRC	00625
5-25-64	NASA-LeRC Veh. Reaffirmation Schedule No. 5	5-20-64	Doc	C	LeRC	00626
5-27-64	Launch Stand Utilization Charts	SSV-101 5-11-64	Charts	C	SSD	00633
5-27-64	Program Management Plan	5-13-64	Doc's	C	NASA Hq	00634
5-27-64	Official NASA Flight Schedule	5-15-64	Doc's	C	NASA Hq	00635
5-27-64	Step Force Test Data For RA D, C, and D	9440-5-10-JCE 5-26-64	TWX	U	LeRC	00639

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5-27-64	Still Photo Report for May	LMSC/A66-2410 D/62-85 B/526 5-22-64	Ltr	U	LMSC	00641
5-27-64	Qualification Test Pyro Helium Control Valve Dwg. #1398662	Report No. 71965 2-19-64	Doc	U	LMSC	00643
5-27-64	Static Structural Qualification Test Evaluation Fwd Section	Structures Rpt. SW/ 40502 A636730	Doc	U	LMSC	00644
5-27-64	MSV Veh. Test Plan Model 43205 Vehicle 6931 & 6932	Vehicle Test Pnal, 43205 6931 & 6932	Doc	U	LMSC	00645
5-27-64	Weight Summary, S-01B	SD4-485 (62-93)	Sum.	U	LMSC	00646
5-27-64	Static Structural Qual: Feel & Oxidizer Sumps	LMSC A636-728 3-5-64	Doc	U	LMSC	00647
5-27-64	Structure Prt. SS-747-5351 Dynamic Duel Summary	LMSC A636-953 3-6-64	Doc	U	LMSC	00648
6-1-64	Med. Space Veh. Program MPR for April	447186-46 5-20-64	Doc	C	LMSC	00654
6-1-64	STD. Agena Perf. Improvement Prog. Payload Gain	LMSC A633-009 1-20-64	Doc	C	LMSC	00658
6-3-64	RFI Test For Ranger 7	9450-6-2-FBG 6-3-64	TWX	U	LeRC	00666
6-4-64	Reproducible Dwgs.	1352 961 1354943	DWGS	U	LMSC	00667
6-5-64	Agena Lunar Performance Panel Agena for 6-10-64	9440-6-3-JPS 6-5-64	TWX	U	LeRC	00671
6-5-64	Lewis Agena Monthly Progress Report	LOGO4050	Doc	C	LeRC	00675
6-5-64	Agena Earth Satellite Perf. Panel	9440-6-2 JPS	TWX	U	LeRC	00676
6-5-64	Dwgs. 1361512, 1347331, 1359965, 1363689, 1363688 1361510A, 1363687	LMSCA603-953-91-11	DWGS	U	LeRC	00677
6-8-64	Weight and Performance Status Report NASA Msns.	SP-38xx-64-1-Rev.2 6-1-64	Doc	U	LMSC	00680

RANGER LAUNCH VEHICLE INTEGRATION

INCOMING DOUCMENTS LIST

Date	Subject	Ref. No.	Type	Cl.	Origin	LV No.
6-8-64	Electromagnetic Interference Control Requirements	447969-B 8-1-64	Doc	U	LMSC	00681
6-9-64	JPL Problem Failure Reports on R Bl. III	9410-GMB 6-5-64	Ltr	U	LeRC	00686
6-9-64	Ranger S/C-Ltr. Interface Action Items Issue #5	9410-GMB 6-8-64	Lt	U	LeRC	00687
6-10-64	Flight Performance Report No. 4-1174-76-64-01	A634753 2-25-64	Doc	C	LMSC	00688
6-10-64	Flight Performance Report No. 4-1175-77-64-01	A639508 4-2-64	Doc	C	LMSC	00689
6-10-64	A08866-21 pgs. 1 & 9 Countdown termn'n Summary A374453-11 pgs. 1 & 3 Agena Flight History Summary	A634753-2 4-29-64	Doc	C	LMSC	00690
6-10-64	Thermo Design Criteria-Atlas/Centaur AC-4 thru AC-9 1st stage	A088866-21; A374543-11 6-11-64	4 pgs.	C	LMSC	00691
6-10-64	Agena Veh. Program Management Plan	22-89-830-493 5-27-64	Doc	C	NASA HW	00693
6-10-64	Basic Dimensions 10205 Reproducible	1313544	1 Dwg.	C	LMSC	00696
6-10-64	List of LMSC Personnel requesting Clearances	LMSC/A603139 6-8-64	Ltr.	U	LMSC	00698
6-11-64	E1310 511 Exit VHF TLM ANT. E1397131 "C" Band Ant.	See Subject	2 Dwgs.	U	LMSC	00702
6-15-64	RA-7 Electro-Explosive Devices Meeting	9421-6-6RSP 6-15-64	TWX	U	LeRC	00704
6-15-64	Revision Pages-C & C Subsystem Ear (NIMBUS)	A376389 6-5-64	2 Doc	U	LMSC	00705
6-15-64	1313544, 1414247A, 1361287B & 1360726A	Dwgs. Rec'd about 6-10-64	Dwgs	U	LMSC	00706
6-16-64	Request for Atlas Ascent Films for JPL	9430-6-3-HSJ 6-15-64	TWX	U	LeRC	00709

Date	Subject	Ref. No.	Type	Cl.	Origin	Lv No.
6-22-64	Wiring Diagram TLM & Beacon 2 sheets	K1342540-D	Dwg.	U	LMSC	00726
6-22-64	Revision Pages-Flight Eval'n ECHO-A-12	A603211	Doc.	U	LMSC	00727
6-22-64	Atlas/Agena/RA-7 Daily Activity Report No. 1	RA-7 Report #1	TWX	U	JPL/AMR	00728
6-23-64	Atlas/Agena/RA-7 Activity Report No. 2	RA-7 Report #2	TWX	U	JPL/AMR	00732
6-24-64	Film on 133D Test 821 Item 1.2-29	Log A63-124F-661 4-26-64	Film	S	GD/C	00734
6-24-64	Film on Ranger 125-121D Item 1.2-29	Log A63-124F-641 1-26-64	Film	S	GD/C	00735
6-24-64	Ltr. to E. G. Fubini from E. Cortright for G. Haddock	SV/JMB:lmg 5-22-64	Ltr	C	NASA Hq	00736
6-24-64	Agena Vehicle Reaffirmation Schedule	Issue No. 1 6-15-64	Sched'l	C	LeRC	00739
6-24-64		Official NASA Flight Schedule	Doc	C	NASA	00740
6-24-64	Atlas/Agena/RA-7 Daily Activity Report No. 3	RA7 Report #3	TWX	U	JPL/AMR	00741
6-24-64	AMR Tracking Requirements REV. 9 of PRD 1800	RA-7 Tracking Req. 6-23-64	TWX	U	GLO	00742
6-25-64	Atlas/Agena RA-7 Daily Activity Report No. 3	RA-7 Report #14 6-24-64	TWX	U	JPL/AMR	00745
6-25-64	Program Management Plan	6-10-64	Doc's	C	NASA	00748
6-25-64	Agena Monthly Progress Report	5-64	Doc's	C	LeRC	00749
6-26-64	Atlas/Agena RA-7 Daily Activity Report No. 5	JPL RA-7 Report #5	TWX	U	JPL/AMR	00754
6-26-64	Proposed Revision to STD for Bl. III LMSC Directed to Incorporate #271739	9410-6-36-GMB	TWX	U	LeRC	00755
6-29-64	Atlas/Agena/RA-7 Daily Activity Report No. 6	RA-7 Report #6	TWX	U	JPL/AMR	00758
6-30-64	AMR Tracking Requirements for RA-7	9450-6-23-GHR	TWX	U	LeRC	00762

Date	Subject	Ref. No.	Type	Cl.	Origin	LV No.
6-30-64	Atlas/Agena/RA-7 Daily Activity Report No. 7	RA-7 Report #7	TWX	U	JPL/AMR	00765
6-30-64	RA-7 Firing Tables & Trajectory Data for Period 9 & 10	LMSC/A604308 6-23-64	TWX	U	LMSC	00766
6-30-64	3 Photo Stills of 6009 Retested	LMSC/A665396 6-25-64	Ltr	U	LMSC	00767
7-1-64	Atlas/Agena/RA-7 Daily Activity Report No. 8	RA-7 Report #8 7-1-64	TWX	U	JPL/AMR	00772
7-1-64	Meetings on Data Evaluation of the LeRC Soft Mount for GE Mock III Guid. Canisters	9410-6-43-GMB 6-30-64	TWX	U	LeRC	00773
7-1-64	Flight Term Syst. RA 6006-6009, EOGO 6501 MR-C 6931 & 6932	A605227	Doc	U	LMSC	00774
7-2-64	Request for GDA Doc BKJ 63-001 S & 63-0014 (C)	9430-7-1-HSJ 7-1-64	TWX	U	LeRC	00775
7-2-64	Meeting to Discuss Verification of Dynamic Flight Data for RA-8 & 9	9421-KFR 6-22-64	Ltr	U	LeRC	00776
7-2-64	Atlas/Agena/RA-7 Daily Activity Report No. 9	RA-7 Report #9 7-2-64	TWX	U	JPL/AMR	00779
7-6-64	Launch Stand Utilization Charts		Doc	C	SSD	00782
7-6-64	Atlas/Agena/RA-7 Daily Activity Report No. 10	RA-7 Report No. 10 7-6-64	TWX	U	JPL/AMR	00784
7-7-64	Launch Schedule, Ranger C	1432-EFS 7-1-64	L r.	C	LeRC	00787
7-7-64	Atlas/Agena/RA-7 Daily Acitivity Report No. 11	RA-7 Report #11 7-7-64	TWX	U	JPL/AMR	00788
7-7-64	Vehicle Reaffirmation Schedule		Doc	C	LeRC	00791
7-7-64	Program Management Plan		Doc	C	NASA	00792
7-8-64	Atlas/Agena/RA-7 Daily Activity Report No. 12	RA-7 Report #12 7-8-64	TWX	U	JPL/AMR	00795
7-8-64	Request for Meeting on JPL's Proposed STO Revisions #A037758-B	9410-7-3-GMB 7-7-64	TWX	U	LeRC	00798
7-9-64	"C" Revision Pages-Atlas/Agena Launch Test Directive		Doc	C	GD/A	00799
7-9-64	Atlas/Agena/RA-7 Daily Activity Report No. 13	RA-7 Daily Report No. 13	TWX	U	JPL/AMR	00801
7-9-64	SLV-3 & SLV-3/Agena D. Performance Workbook		Doc	C	GD/C	00802
7-10-64	Meeting at ETR RE: Sto Inputs #A037758-B	LMSC/A604544 7-10-64	TWX	U	LMSC	00805
7-10-64	Atlas/Agena/RA-7 Daily Activity Report No. 14	RA-7 Report No 14 7-10-64	TWX	U	JPL/AMR	00806
7-13-64	Atlas/Agena/RA-7 Daily Activity Report No. 15	RA-7 Report No. 15 7-13-64	TWX	U	JPL/AMR	00810
7-14-64	Atlas/Agena/RA-7 Daily Activity Report No. 16	RA-7 Report No. 16	TWX	U	JPL/AMR	00813
7-14-64	48 page paper on Atlas/Flox-Aerospace Propuls. Mtg.		Doc	C	Rocket-Dyne	00815
7-14-64	Range Safety Command System Acceptance Test Procedure - SLV-3		Doc	U	GD-C	00831
7-15-64	Atlas/Agena/RA-7 Daily Activity Report No. 17	RA-7 Report No. 17	TWX	U	JPL/AMR	00833
7-16-64	Factors Considered for Setting Ranger VII Velocity Meter	LMSC R1422 7-16-64	TWX	U	LMSC	00837
7-16-64	Atlas/Agena/RA-7 Daily Activity Report No. 18	RA-7 Report No. 18 7-16-64	TWX	U	JPL/AMR	00839
7-16-64	Weight & Performance Status Report NASA Missions		Doc	U	LMSC	00840
7-17-64	Addition to LMSC RA-B Procedures	Ltr. fm. Zweigbaum to Hutchins 7-13-64	Ltr	U	GSFC/	00843
7-17-64	Atlas/Agena/RA-7 Daily Activity Report No. 9	RA-7 Report No. 9 7-17-64	TWX	U	JPL/AMR	00844
7-20-64	Request for Approval to Launch RA-B	ETORS-3 7-13-64	Ltr	U	HQ AFETR	00848
7-20-64	Additional Documentation Regarding ETR Station le TM Data Analysis Effort for Ranger 7	9421-WHZ 7-7-64	Ltr	U	LeRC	00849

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7-20-64	LeRC Action Items from the Ranger Quarterly Mission Review, Mtg. at JPL	9410-GMB 7-16-64	Ltr	U	LeRC	00850
7-20-64	Confirmation of Launch Criteria for Ranger Flight RA-7 Vehicle 6009	LMSC/A604617	Ltr	U	Lockheed Aircraft Corp.	00851
7-20-64	Atlas/Agena/RA-7 Daily Activity Report No. 20	RA-7 Report No. 20 7-20-64	TWX	U	JPL/AMR	00852
7-21-64	(A) Reversal of RF Connectors (B) Locking of Spacecraft Snubber Bolts	P/FR RA-6 and Ranger B 7-16-64	IOM	U	JPL/AMR	00856
7-21-64	Distribution of GD/A Documentation for Space Launch Vehicles	JSB-d1641-3-182	Ltr	U	GD/A	00857
7-21-64	Official NASA Flight Schedule		Doc	C	NASA Hq	00860
7-21-64	Agena Launch Vehicle Program		Doc	C	NASA	00863
7-21-64	NASA Atlas B Fact, OP. Directive No. 4811		Doc	C	AFMTC	00864
7-21-64	NASA Agena RF Functional Test, OD #4832		Doc	C	AFMTC	00865
7-21-64	Atlas/Agena/RA-7 Daily Activity Report No. 21	RA-7, Report No. 21 7-21-64	TWX	U	JPL/AMR	00866
7-22-64	Final Launch Criteria for Ranger flt. Vehicle 6009	LMSC/A604665 7-21-64	TWX	U	LMSC	00869
7-22-64	Atlas/Agena/RA-7 Daily Activity Report No. 22	RA-7 Report No. 22 7-22-64	TWX	U	JPL/AMR	00872
7-23-64	Atlas/Agena/RA-7 Daily Activity Report No. 23	RA-7 Report No. 23 7-23-64	TWX	U	JPL/AMR	00878
7-24-64	Atlas/Agena Electrical Transients-Request for Info.	9421-7-5-KFR AFSSD 7-24-64	TWX	U	LeRC	00883
7-24-64	Atlas/Agena Electrical Transients - Request for Info.	9421-7-4-KFR AMSC 7-24-64	TWX	U	LeRC	00884
7-24-64	Sequence of events Model		Doc	U	LMSC	00885
7-28-64	Monthly Progress Report June 64		Doc	C	LeRC	00890
7-28-64	Pages 1 & 11 Countdown Termination Summary; Pages 1 & 3 Agena Flight History Summary	LMSC/A604564-91-40 7-14-64	Doc	C	LMSC	00891
7-28-64	Op'ns Requriement No. 1801, NASA Ranger Launch RA7 & 9		Doc	C	NASA	00892
7-28-64	Rev. 6 to Operations Directive 1801		Doc	C	USAF NRD	00893
7-28-64	Rev. 7 to Operations Directive 1801		Doc	C	USAF NRD	00894
7-29-64	2 sets of 3 pictures of Agena at Cape	A668863 7-24-64	Ltr.	U	LMSC	00901
7-30-64	Meeting on Verification of Dynamic Flt. Data RA-8 & 9 @ Ptx. Arguello, California	9421-7-7-KFR	TWX	U	LeRC	00906
8-3-64	Subsystem A. Engineering Analysis Report NAS3-3800	LMSC/A602349-91-34 7-30-64	Ltr	U	LSMC	00918
8-3-64	Request for Documentation	SSD/SSVZE Capt Spolidora 7-23-64	Ltr	U	HQ SSD	00919
8-5-64	ETR/CK/MILA & Weight Launch Facilities Utilisation		Doc	C	HQ	00933
8-7-64	Meeting to Discuss Verification of Dynamic Flight Data	LMSC/R042030 8-6-64	TWX	U	LMSC	00940
8-7-64	Meeting to Discuss Verification of Dynamic Flt. Data RA-8 & 9	LeRC9410-8-7-GMB 8-6-64	TWX	U	LeRC	00941
8-7-64	Meeting to Discuss Verification of Dynamic Flt. Data RA-8 & 9	LeRC9421-8-2-KFR 8-5-64	TWX	U	LeRC	00942
8-10-64	AMR Shipper Nos.	JPL 001 8-7-64	TWX	U	JPL/AMR	00945
8-12-64	Agena Launch Vehicle Program		Doc	C	NASA	00953
8-12-64	Atlas SLV-3/LTV Velocity Package for Boosting Pioneer		Doc	C	GD/A	00954

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8-12-64	Countdown Termination Summary Flight History Summary	LMSC/A604814-91-40 7-3-64	4 Pgs	C	LMSC	00955
8-12-64	SLV-3 & SLV-3 Agena D Performance Workbook		Doc	C	GD/A	00957
8-14-64	Weight and Perf Statis Report-NASA Missions	LMSC/A604739 8-64	Doc	U	LMSC	00964
8-18-64	Project Agena, Ranger 7 Flash Flts. Report, T + 8 Hours	GLOR-105	Doc	U	LeRC	00971
8-18-64	19 Ranger Drawings 10205-6007	LMSC/A604932 8-12-64	Dwgs	U	LMSC	00973
8-21-64	Ranger 7 Launch Report	LMSC-273081 8-14-64	Doc	S	LMSC	00988
8-24-64	Agena Program Management Plan	9411-8-4-LWC 8-20-64	TWX	U	LeRC	01000
8-26-64	Req. for Approval to Launch Ranger B (RA-7)	ETQDA/F.C. Drury 2-29-64	Ltr	U	AFETR	01004
8-26-64	Agena Launch Vehicle Program		Doc	C	NASA	01005
8-26-64	NASA-LeRC Vehicle Reaffimation Sked #2 & 7		Doc	C	NAS/LeRC	01006
8-26-64	Prelim. Flt. Test Report-Mod III Guid. LV250D, RA-B		GE/Burroughs	S	01007	
8-27-64	16MM Film-Work Print-Test 0448 MT 64-29683		Film	S	AFMTC	01012
8-27-64	Official NASA Flight Schedule		Doc	C	NASA	01013
8-31-64	Engineering Sequential Film; 1.2-13 (w/o Timing) 3 copies		Ltr	U	LeRC	01023
8-31-64	Agena Monthly Progress Report		Doc	C	LeRC	01026
9-1-64	Ltr. W/2 sets Photos (19 ea. set)	LMSC/A702633 8-28-64	Ltr.	U	LMSC	01033
9-3-64	Matchmate Schedule Dates for RA-8 & 9	9410-9-2-GMB 9-2-64	TWX	U	NASA/LeRC	01039
9-3-64	Meeting to Discuss Verification of Dynamic Flt. Data RA-8 & 9	9410-9-3-GMB 9-2-64	TWX	U	NASA/LeRC	01040
9-4-64	Agena Program Mangement Report as of September 12, 1964	9401-9-1-LWC	TWX	U	LeRC	01050
9-8-64	Evaluation Report of Mod III Radio Guidance and Inst. System with Launch Vehicle 250D, Ranger 7	AF04(695)-475 9-4-64	Doc	S	GE	01058
9-11-64	LV-3A Electrical Transients	643-4-126 8-27-64	Ltr	U	GD/A	01070
9-14-64	Meeting to Discuss Verification of Dynamic Flight Data for Ranger 8 & 9	LMSC/A605291 9-12-64	TWX	U	LMSC	01079
9-15-64	Ranger Block III Match Mate of Ranger 8 and 9	LMSC/A605292 9-11-64	TWX	U	LMSC	01083
9-15-64	Agena Launch Vehicle Program			C	NASA/Wash	01087
9-15-64	Agena Launch Vehicle Program			C	NASA/Wash	01088
9-15-64	LV-3A Test Parameters for Factory and AMR Book No. 1	9402-WKF 9-2-64	Ltr	C	NASA/LeRC	01092
9-16-64	Contract NAS3-3805, Task Order #9 Agena Mission Std. Rqmts.	LMSC/A605197-67-40	Ltr	U	LMSC	01096
9-17-64	Ranger 6 Launch Vehicle System Success Analysis Addendum (Uncl)	SS30.1-214 4-24-64	Ltr	S	Lear Siegle	01098
9-17-64	Generation of Firing Tables for Ranger 8 and 9 Contract.	LMSC-R142230 9-15-64	TWX	U	LMSC	01099
9-18-64	Door Frame w/Rev. B-1 B-2, & B-3	J1365325 Rev. B	Dwg.	U	LMSC	01107
9-21-64	Test Summary Report, Type IV Guidance Power Converter	9430-ERP 9-4-64	Ltr	U	LeRC	01115
9-21-64	Minutes of Meeting; Dynamic Flight Data for Rangers 8 & 9	9410:GM Bode:keb 9-17-64	Ltr	U	LeRC	01116
9-25-64	Dates for Matchmate of RA-8 and 9	9410-9-22-GMB 9-24-64	TWX	U	LeRC	01133
9-28-64	Updating of the Instrumentation Handbook for Veh 6006-6009	9421-KFR 9-24-64	Ltr	U	LeRC	01137

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9-30-64	Satellites Probes Program Progress Report	LMSC/A605482-80 9-23-64	Ltr	C	LMSC	01150
9-30-64	Atlas Agena Range Safety Report for ETR	A605 426 9-25-64	Doc	C	LMSC	01151
10-1-64	Flight Evaluation & Performance Report for Ranger 7 Mission	LMSC/A605551-91-37 9-28-64	Ltr.	C	LMSC	01157
10-1-64	Countdown Termination Summary & Agena Ascent Flight History Summary	A605470-91-40 9-24-64	Ltr	C	LMSC	01159
10-1-64	Agena Launch Vehicle Program		Doc	C	NASA/Wash	01160
	Monthly Progress Report by Agena P		Doc	C	NASA/LeRC	01180
	NASA/LeRC Vehicle Reaffirmation Schedule Issue No. 8		Doc	C	NASA/LeRC	01181
	NASA/LeRC Agena Vehicle Reaffirmation Schedule Issue No. 3		Doc	C	NASA/LeRC	01182
10-6-64	Ranger 7 Post Flight Minutes Action Items	9410-10-3-GMB 10-6-64	TWX	U	LeRC	01184
10-7-64	Polaris Transducer Calibration Equipment System	9410-10-5-GMB 10-5-64	TWX	U	LeRC	01186
10-9-64	Project Agena Ranger 7 Flash Flight Hour T + 8 Hours		Doc	S	Goddard	01201
10-9-64	Supplement to Ranger 7 Post-flight Minutes-Action Item Assignments	MSG No. 003 10-7-64	TWX	U	JPL/AMR	01202
10-9-64	Ranger Dynamic Instrumentation	9410-10-6-GMB 10-8-64	TWX	U	LeRC	01203
10-9-64	Telemetry Channel 17 for Ranger 9	9410-10-8-GMB 10-9-64	TWX	U	LeRC	01206
10-9-64	Ranger 7 Post Flight Minutes-Action Items	9410-10-7-GMB 10-9-64	TWX	U	LeRC	02107
10-9-64	SLV-3 Test Parameters for Fact and AMR		Doc	C	GD/A	01209
10-9-64	Flight Term System Report Rev. C	LMSC/A704717 10-6-64	Doc	U	LMSC	01211
10-12-64	C & C Subsystem Engineering Rpt. Agena Vehicles 6007 through 6009	946-EIL 9-23-64	Ltr	U	LeRC/LMSC	01215
10-15-64	ETR Teletype ling Between Station 13 and KSC	9450-FEG 10-3-64	Ltr	U	LeRC	01221
10-15-64	Ranger 7 Post Flight Minutes Action Items	9410-10-14-GMB 10-14-64	TWX	U	LeRC	01222
10-15-64	Ranger 7 Post Flight Review AFETR Action Items	JPL IOM f. H. N. Levy to H. M. Schurmeier	IOM	U	JPL/AMR	01223
10-16-64	Agena Launch Vehicle Program		Doc	C	NASA/Wash	01228
10-19-64	Ranger Dynamic Instrumentation	9410-10-16-GMB 10-15-64	TWX	U	LeRC	01233
10-22-64	Table V Launch Vehicle VS Injection Accuracy		Ltr	C	LeRC	01248
10-22-64	Table IV Launch Vehicle VS Injection Accuracy		Ltr	C	LeRC	01249
10-22-64	Official NASA Flight Schedule		Doc	C	NASA/Wash	01250
10-21-64	Weight and Performance Status Test		Doc	U	LMSC	01253
10-23-64	Ranger 7 Post Flight Minutes Action Items	9410-10-29-GMB 10-23-64	TWX	U	LeRC	01265
10-26-64	Agena Program Management Report for Period Ending October 14, 1964	9410-10-2-LWC 10-21-64	TWX	U	LeRC	01268
10-28-64	Radio Guidance & Inst. Sup. with Launch Vehicle 195D		Doc	S	GE	01279
10-28-64	Agena Launch Vehicle Program		Doc	C	NASA/HQ	01280
10-28-64	Atlas Vehicles for Fire-2 Ranger C and Ranger D Missions	9410-10-31-GMB	TWX	U	LeRC	01283
10-30-64	Launch Complex 12 ETR Gantry Location	9410-10-32-GMB 10-29-64	TWX	U	LeRC	01288

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11-2-64	Quick Look Data Report (Part 1 & 2) Vols. No. 3, 4 and 5	9460:ejk 10-28-64	Ltr	C	LMSC	01300
11-2-64	Sat. & Probs. Program Prog. Rept. for September 1964	A709005162-80 10-26-64	Ltr	C	LMSC	01302
11-6-64	NASA/LeRC Vehicle Reaffirmation Sched. Issue No. 8 Add. 1		Docs	C	LeRC	01320
11-6-64	Satellite & Probes Program Progress Report		Doc	C	LMSC	01321
11-12-64	Agena Launch Vehicle Program Management Plan		Doc	C	NASA/Wash	01343
11-12-64	Weight & Performance Status Report	LMSC-A709038 11-1-64	Docs	U	LMSC	01347
11-18-64	Effect on Launch Probability Due to 30% Flox in Atlas (to L. S. Blomeyer)	632-0-119 11-16-64	Letr & Doc	U	GD/A	01364
11-18-64	Feasibility Testing 50% Flox with Atlas Oxidizer System Components		Ltr	C	GD/A	01365
11-18-64	Feasibility Testing 30% Flox with Atlas Oxidizer System Components		Ltr	C	GD/A	01366
11-18-64	30% Flox-Atlas SLV-3 Operational Program		Ltr	C	GD/A	01367
11-18-64	Operational Atlas SLV-3 Performance Improvements Program		Ltr	C	GD/A	01368
11-18-64	Encl. A, B, C, and D. Atlas Performance Curries & Capabilities		Ltr	C	GD/A	01369
11-18-64		SLV-3 Atlas Flox Performance Summary	Ltr	C	GD/A	01371
11-18-64	Pages 1 & 3 of Agena Flight History Summary	LMSC/A651452-91-40 11-12-64	Ltr	C	LMSC	01372

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11-18-64	Monthly Progress Rept. by Agena Proj.		Doc	C	NASA/LeRC	01373
11-18-64	Request for Documents	9410-11-8-GMB 11-18-64	TWX	U	LeRC	01374
11-19-64	The Agena Earth Satellite and Lunar Performance Panel Meetings	9440-11-2-JPS 11-18-64	TWX	U	LeRC	01382
11-24-64	Agena Launch Vehicle Program		Doc	C	NASA/Wash	01399
11-24-64	NASA Official NASA Flight Schedule		Doc	C	NASA/Wash	01400
11-25-64	5 Reports - LMSC/A393631, A394451, A669239, with Addendums	LMSC/A652820-91-10 11-19-64	Ltr	U	LMSC	01413
11-30-64	Wiring Diagram Spacecraft to Interface (Plus EO NG-1)	LMSC/A652854 11-24-64	Dwg.	U	LMSC	01424
12-1-64	Quick Look Data RA-6 - Vol. I and III		Doc	C	LMSC	01428
12-1-64	Satellites & Probes Program Progress Report, October 1964	A652813-62-80	Doc	C	LMSC	01429
12-17-64	A Proposal to Increase SLV-3/ Agena Payload Cap. SLV-3		Doc	C	GD/A	01446
12-8-64	New Catenary Cable Configuration for Ranger	9450-12-2-FEG 12-4-64	TWX	U	LeRC	01447
12-8-64	Ranger 7 Postflight Minutes-Action Items	9410-12-5-FMB 12-5-64	TWX	U	LeRC	01448
12-9-64	Meetingto Review the Acceleration End-to-End Calibration Procedure for Rangers C & D	9410-12-7-GMB 12-8-64	TWX	U	LeRC	01449
12-11-64	Reinspected AC Transformers in the Flight Control System		TWX	U	LeRC	01455
12-14-64	Still Photo Report for November	LMSC/A653409, D-62-80, B526 11-25-64	Ltr	U	LMSC	01457
12-17-64	Agena Program Management Plan Report for Period Ending Dec. 9, 1964	9401-12-3-LWC 12-17-64	TWX	U	LeRC	01462

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12-21-64	Program Requirements Rev. Control Sheet, Telemetry System Transponders & Beacon	LMSC/A653573-91-37 12-14-64	Ltr	U	LMSC	01465
12-28-64	Photographs	LMSC/A654979-62-80 12-18-64	Ltr	U	LMSC	01466
12-22-64	Agena Ascent Flight History Summary		Doc	C	LMSC	01468
12-22-64	Agena Launch Vehicle Program		Doc	C	NASA/Wash	01469
12-23-64	Weight & Performance Status Report		Doc	U	LMSC	01472
1-4-65	Agena Program Mangement Plan Report for Period Ending 12-23-64	9401-12-5-AWM 12-30-64	TWX	U	LeRC	01480
1-6-65	Sequence of Events, Model 10205, Veh. 6007	1371019 12-17-64	Docs	U	LMSC	01482
1-6-65	Test Procedure FCP-C60602-A, Vehicle Instrumentation Checkout and Calibration	9421-KFR 12-30-64	Ltr	U	LeRC	01489
1-11-65	RFI Test for Ranger C	REF9450-12-14-FEG 1-6-65	TWX	U	NASA/Cape	01498
1-8-65	Official NASA Flight Schedule		Doc	C	NASA HQ	01499
1-12-65	Agena Launch Vehicle Program		Doc	C	NASA	01506
1-14-65	Study of GE/Burroughs ASCO for Mar 64	9440-1-7-KAA 1-13-65	TWX	U	LeRC	01512
1-15-65	Pages 1-3 of Agena Flight History Sum.	LMSC/A728466-91-40 1-6-65	Doc	C	LMSC	01517
1-18-65	Sequence of Events for Vehicle 6006	LMSC/1342655-F 1-11-65	Doc	U	LMSC	01518
1-18-65	Vehicle Instrumentation Checkout & Cal	C60602-C	Doc	U	LMSC	01519
1-18-65	Telemetry System Validation Test 10205 19205	C60601-B	Doc	U	LMSC	01521
1-18-65	Telemetry System Validation Test 10205 19205	C60601-A	Doc	U	LMSC	01520

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1-18-65	LMSC Drawing 1361287	9410-1-15-GMB 1-15-65	TWX	U	LeRC	01525
1-19-65	End-to-End Telemetry System Calibration for Ranger C	9510-1-4-GMB 1-9-65	TWX	U	LeRC	01526
1-19-65	End-to-End Telemetry System Calibrations for Rangers C and D	9410-1-5-GMB	TWX	U	LeRC	01527
1-19-65	Agena Launch Vehicle Program PMP		Doc	C	NASA/Wash	01529
1-20-65	Agena Vehicle Reaffirmation Schedule		Doc	C	NASA/LeRC	01534
1-22-65	Satellites & Probes Program Progress Report, NAS3-3800, 3-3802	LMSC/A730535 1-20-65	Ltr	U	LMSC	01538
1-22-65	Retract Test of Ranger Umbilicals	9450-1-12-FEG 1-21-65	TWX	U	LeRC	01540
1-25-65	Test Procedure, Accelerometer and Vibration Systems Calibration		Doc	U	LMSC	01546
1-25-65	Ranger Agena Vehicle Instrumentation Handbook	LMSC/A730521 1-14-65	Ltr	U	LMSC	01548
1-25-65	Atlas/Agena Performance Improvement Study Software Changes		Doc	C	LMSC	01550
1-25-65	Weight & Performance Status Report		Doc	U	LMSC	01551
1-25-65	Possible Ranger Spacecraft Contamination from Atlas Retro Rockets	9410-1-19-GMB	TWX	U	LeRC	01552
1-26-65	Ranger 6006 Re-Matchmate Test Summary Report; Ranger 6006 Matchmate Test-Matchmate of Vehicle 6006 Nose Cone and Adapter	LMSC/A731460-91-40 1-20-65	Ltr	U	LMSC	01554
1-26-65	Launch Vehicle/Spacecraft Interface Action Items for Ranger Project	9410-GMB 1-22-65	Ltr	U	NASA/LeRC	01558

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1-26-65	End-to-End Calibration Procedure Vehicle 6006 Document Request	9421-KRF 1-22-65	Ltr	U	NASA/LeRC	01559
1-27-65	Twenty Ninth Lunar Performance Panel & Twenty Eighth Earth Satellite Panel	9440-1-12-EHD 1-25-65	TWX	U	NASA/LeRC	01560
1-28-65	LMSC Dwgs. D1545779, w/EO NCL and DWG E1550696	1-26-65	Dwgs	U	LeRC/LMSC	01561
1-28-65	Agena Program Mangement Plan, Report for Period Ending Jan. 20, 1965	9410-1-6-AWM 1-27-65	TWX	U	LeRC	01564
1-29-65	Interdepartmental Comm w/ Flash Reports SPL/288; F11225, 1 & 2	1-29-65	Docs	U	LMSC	01572
1-29-65	LMSC Dwg. J1359963A W/EOs "A" 2 sets "A"1 2 sets, "A2" 1 set		Dwgs	U	LMSC	01573
2-3-65	SLV-3 and SLV-3 Agena d performance Workbooks		Doc	C	GD/A	01576
2-3-65	Agena Launch Vehicle Program PMP		Doc	C	NASA/Wash	01577
2-4-65	Mariner D Agena Vehicle 6932 Flight Evaluation & Performance	LMSC/A732251-91-37 1-28-65	Ltr	U	Ltr	01580
2-5-65	Operations Directive #1801 NASA Ranger Launch Block III		Doc	C	Cape	01583
2-5-65	Progress Rept. Months of Oct., Nov., Dec. 1964 Agena Project		Doc	C	NASA/LeRC	01584
2-5-65	Confirmation of Launch Criteria for Ranger Flight Vehicle 10205-6006	LMSC/A733405-91-37 2-4-65	TWX	U	LMSC	01585
2-3-65	Reuqested Change in Orientation of Accelerometer PL20 for Veh. 6007	9421-KFR 2-3-65	Ltr	U	LeRC	01586
2-8-65	Reliability Estimate and Analysis Report, Block 3 Ranger Program	LMSC/A733453/91-40 2-5-65	Ltr	U	LMSC	01591
2-9-65	Security Classification for NASA/LeRC Agena Missions	9450-2-2-ALG 2-8-65	TWX	U	LeRC	01593
2-9-65	Agena Ascent Flight History Summary	A733401-91-40 2-4-65	Doc	C	LMSC	01595
2-9-65	RA-6 - RA-9 Pages 4-3 Rev. for SVS Test Objectives for Ranger Project Flight	A728450 D-37 2-2-65	Doc	C	LMSC	01596
2-10-65	End-to-End Calibration Rangers C and D Telemetry Performance Tests	9420-2-1-REA 2-8-65	TWX	U	NASA/LeRC	01602
2-10-65	Change Record for Ranger 6 Agena Vehicle 6008 Flt. Eval. & Perf. Anal.	A732587-91-20 2-5-65	Doc	C	LMSC	01603
2-10-65	Rev. Pages Flt. Termination System Report	A732585 2-5-65	Ltr.	U	LMSC	01604
2-11-65	ASCO for Rangers 8 and 9	9440-2-2-KAA 2-10-65	TWX	U	NASA	01605
2-11-65	Final Launch Criteria TEX for Agena Vehicle 10205-6006	LMSC/A733496 2-9-65	TWX	U	LMSC	01606
2-15-65	LMSC/A048135-19, 20, 21, 22, 23,25,26, and 1360994-Veh. Test Plan	9401-GTH 2-10-65	Ltr	U	NASA/LeRC	01612
2-15-65	Ranger 6007 Matchmate Test, Summary Report	LMSC/A734153-91-40 2-10-65	Ltr	U	LMSC	01613
2-15-65	Operations Dir. #1801 Rev. 9 NASA Ranger Launch Bk III 63 & 63A		Doc	C	Cape NASQ	01614
2-15-65	Final Calibration Rept. Rev. 6006 2 pages of Pag. 8	LMSC/A732578-91-10 2-9-65	Doc	C	Lockheed	01615
2-15-65	Umbilical Lanyard Operation for Ra C	9450-2-7-FEG 2-12-65	TWX	U	LeRC	01616
2-16-65	Shroud Clearance Analysis, Ranger 8 for simultaneous Sep & POP	LMSC/A734519 2-15-65	TWX	U	LMSC	01617
2-17-65	Agena Project Policy on Dissemination of Documents	9400-CCC 2-16-65	Ltr	U	LeRC	01618

Date	Subject	Ref. No.	Type	Cl.	Origin	LV No.
2-18-65	Propellant Loads for Agena Vehicle 6006 Model 10205	LMSC/A734567-91-37 2-16-65	TWX	U	LMSC	01619
2-18-65	Amendment to Final Launch Criteria TWX for Agena Vehicle 10205-6006	LMSC/A734576-91-37 2-17-65	TWX	U	LMSC	01620
2-19-65	Atlas/Agena Working Group Launch Test Directive Ranger Block III Rev. ETP		Doc	C	LMSC	01628
2-19-65	Launch Test Dir. for Ranger Block III pgs. iif, w, 38, 48D & 48J		Doc	C	LMSC	01629
2-19-65	Agena Launch Vehicle Program PMP		Doc	C	NASA/Wash	01630
2-19-65	Official NASA Flight Schedule		Doc	C	NASA/Wash	01631
2-23-65	Atlas/Agena Flash Flight Report, RA C	GLOR 159 2-17-65	Doc	U	GLO/LeRC	01634
2-23-65	Agena Program Management Plan Report for Feb. 3, 1965	9401-2-3-AWM 2-9-65	TWX	U	LeRC	01635
2-23-65	Agena Program Management Plan Report for Feb. 14, 1965	9401-2-5-AWM 2-18-65	TWX	U	LeRC	01636
2-25-65	Official NASA Flight Schedule		Doc	C	NASA/Wash	01638
2-25-65	Vehicle 6006 Final Calibration Rev. 2 5 pages classified	LMSC/A735416-91-10	Doc	C	LMSC	01640
3-2-65	Still Photo Report for February	LMSC/A735173-B/526-D/62-80 2-25-65	Ltr	U	LMSC	01644
3-3-65	Agena Launch Vehicle Program PMP		Doc	C	NASA/Wash	01645
3-3-65	Final Calibration Rev. #1, Ranger Vehicle 6007	LMSC/A736019-91-10	Doc	C	LMSC	01646
3-3-65	Satellites & Probes Program Progress Report January 1965	LMSC/A736009 2-25-65	Ltr	U	LMSC	01647

Date	Subject	Ref. No.	Type	Cl.	Origin	LV No.
3-9-65	Agena Ascent Flight History Summary	A736691-91-40	Doc	C	LMSC	01651
3-9-65	Countdown Termination Summary Page 1 & 13		Doc	C	LMSC	01652
3-9-65	Ranger 6006 - Step Force	Handcarried to JPL	Tapes	U	LMSC	01654
3-11-65	Revision Pages Flight Termination Systems Report	LMSC/A740002 3-9-65	Ltr	U	LMSC	01657
3-12-65	Ranger 8 Post Flight Analysis Action Item	9410-3-20-GMB	TWX	U	LeRC	01658
3-12-65	End-to-End Calibration of Ranger VIII Dynamic Instrumentation	9460-WEF 3-10-65	Ltr	U	LeRC	01659
3-12-65	Confirmation of Launch Criteria for Ranger Flight Vehicle 10205-6007	LMSC/A740010-1-37 3-5-65	TWX	U	LMSC	01660
3-12-65	Agena Program Management Plan, Report for Period Ending March 3, 1965	9401-3-3-LWC 3-10-65	TWX	U	LeRC	01661
3-15-65	Titan IIIx/Agena Standard Data Book for Perf. Cal. & Trajectory simulation		Doc	C	Aero-space	01663
3-16-65	NASA/Atlas/Agena Launch Operations Working grp. Ranger 8	273177/76-22 3-9-65	Doc	S	LMSC	01665
3-16-65	Agena Launch Vehicle Program PMP		Doc	C	NASA/Wash	01666
3-17-65	Final Launch Criteria TWX for Agena Vehicle 10205-6007	LMSC/A940971-91-37 3-15-65	TWX	U	LMSC	01668
3-18-65	Vehicle Reaffirmation Schedule Issue #10		Doc	C	NASA/LeRC	01669
3-19-65	Monthly Progress Report by Agena Prj.		Doc	C	NASA/LeRC	01670
3-22-65	Final Launch Criteria TWX for Agena Vehicle 10205-6007	LMSC/A940971-91-37 3-19-65	TWX	U	LMSC	01672

Date	Subject	Ref. No.	Type	Cl.	Origin	LV No.
3-22-65	Final Calibration Report 6007 4 sheets	A741720-91-10 3-15-65	Doc	C	LMSC	01674
3-23-65	Official NASA Flight Schedule		Doc	C	NASA	01676
3-23-65	Rev. H. Working Grp. Launch Test Obj. Ranger Block III		Doc	C	Cape	01677
3-23-65	Final NASA Vehicle 6009 Calibration Report Revision (Originally requested by JPL Letter RA-LV-90656 Dated 12-22-64	9421-WHZ 3-18-65	Ltr	U	LeRC	01679
3-24-65	Final Calibration Report Vehicle 6007 Revision 3 4 pages	A7417591-91-10 3-16-65	Doc	C	LMSC	01680
3-29-65	Satellites & Probes Program Progress Report	A742901 3-26-65	Doc	U	LMSC	01682
3-30-65	Agena Launch Vehicle Program PMP		Doc	C	NASA	01684
3-30-65	Agena Vehicle 6006- Still Photo Report	LMSC/A741989-B/526-D/62-80	Ltr	U	LMSC	01685
3-31-65	End-to-End Calibration of Ranger IX Dynamic Instrumentation	LMSC/A742983 & Rep. No. J-D1-65-2 3-26-65	Ltr	U	LMSC	01686
4-5-65	Atlas/Agena Flash Flight Report for Ranger D (RA-9)	GLOR-167 3-21-65		U	GLO	01687
	Agena Monthly Progress Report for Feb. 65		Doc	C	LeRC	01689
4-7-65	Ranger/Agena Vehicle 6006 Flight Eval. & Perf. Analysis Report	A-743591-91-20 4-3-65	Ltr	C	LMSC	01690
4-13-65	Agena Launch Vehicle Plan PMP			C	NASA	01693
4-13-65	Countdown Termination Summary Pages 1 & 13	LMSC/A744169-91-40 4-7-65	Ltr	U	LMSC	01694
		Agena Flight History Summary		C	LMSC	01695
4-16-65	NASA/Atlas/Agen Launch Operations Group Ranger 9	LMSC/273225	Ltr	S	LMSC	01697
4-16-65	Utilization Charts 6 pages		Doc	C	AFSC-SDD	01698

Date	Subject	Ref. No.	Type	Cl.	Origin	LV No.
4-19-65	Final Ranger Quarterly Review	9410-4-11-GMB 4-16-65	TWX	U	LeRC	01701
4-19-65	Final Ranger Project Quarterly Review	P161730Z 4-7-65	TWX	U	Cape	01702
4-19-65	Evaluation Report of Mod. III Radio Guidance & Inst. Sys. Launch Vehicle 1960 Ranger 8	AF04(695(-475 4-7-65	Ltr	S	GE	01703
4-20-65	Weight and Performance Status Report, NASA Agena Satellite and Probe Missn.	LMSC/A605116-7-SSD-3800-65-9 4-1-65	Doc	U	LMSC	01704

APPENDIX G

LAUNCH-VEHICLE INTEGRATION

OUTGOING DOCUMENTS LIST

Appendix G contains the Ranger portion of the Section log, beginning in January 1963, for outgoing documents including letters, TWXs, and IOMs.

RANGER LAUNCH VEHICLE INTEGRATION

OUTGOING DOCUMENTS LIST

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS
1-7-63	Transmittal of JPL Drawings 7 & 8	Ltr	D. E. Forney	HMS/RER:jap
1-28-63	Transmittal of JPL Documents	Ltr	S. C. Himmel	RJP/JTO:jlw
2-21-63	Transmittal of JPL Ranger 9 Drawings	Ltr	D. E. Forney	JMS/DJS/RER:mdl
2-19-63	JPL Technical Requirement No. 12 RA	Ltr	S. C. Himmel	HMS/WJL/DJS:bf
2-20-63	JPL, Engineering Planning Document No. 133	Ltr	D. E. Forney	HMS/PJR/DJS:mdl
2-26-63	EM Adapter and Forward Equipment Rack	Ltr	D. E. Forney	HMS/WJL/DJS:jlw
2-26-63	Transmittal of JPL Ranger 6, 7 & 8 Drawings	Ltr	D. E. Forney	HMS/RER:mdl
2-28-63	Transmittal of IOM "Ranger Block III Launch Periods and Injection Energies"	Ltr	N. E. Schwalm	HMS/RCH/JTO:flw
3-27-63	TR No. 13 Determination of Several Software Changes on Atlas/Agena	Ltr	S. C. Himmel	HMS/RCH:mdl
3-7-63	Transmittal of JPL Ranger Block III Drawings	Ltr	D. E. Forney	HMS/RER:bf
3-7-63	Fairchild-Stratos Corporation, Ranger 6-9 Spacecraft Reliability Study	Ltr	R. E. Pace	RJP/WKG/SRS:mdl
3-14-63	Request for Technical Information	Ltr	D. E. Forney	HMS/SRS/RER:mdl
3-19-63	Use of RA-9 as a back-up spare for RA-8 Msn	Ltr.	S. C. Himmel	HMS/WJL/mdl
3-26-63	Transmittal of JPL Ranger Block 3 Drawings	Ltr	D. E. Forney	HMS/WJL/DJS:mdl
3-28-63	Revised JPL Spec. for Vehicle System Integration; Ranger Block III	Ltr	D. E. Forney	HMS/WJL/DJS:jf
4-5-63	List of Scheduled Ranger-Mariner Meetings	TWX	D. E. Forney	J. T. Ofer
4-17-63	Transmittal of JPL RA-Block 3 Drawings	Ltr	D. E. Forney	HMS/RER:jf
4-17-63	Request for Environmental Specifications	Ltr	S. C. Himmel	HMS/WJL:jf
4-19-63	Review of Ranger Block IV Interface Specs.	Ltr	S. C. Himmel	HMS/WJL:jf
4-19-63	Review of RA Block IV Interface Specs.	IOM	HMS/GPK	WJL/DJS:jf
4-19-63	Weekly List of Scheduled Ranger Mariner Mtgs.	TWX	D. E. Forney	J. T. Ofer
4-22-63	Ranger Block 3 Spacecraft Weight Status as of 19 April 63	TWX	D. E. Forney	HMS
4-26-63	Firing Tables, Trajectory Data and Trajectory Generation Schedule Ranger V Project	Ltr	R. Rovenger	WEG/LSB/SRS:mdl
5-1-63	Change to JPL Spec. 30947 B	Ltr	S. C. Himmel	HMS/WJL/DJS:mdl
5-6-63	Launch Azimuth Sector Waiver Request	Ltr	S. C. Himmel	HMS/JTO/DJS:mlw
5-7-63	Request for Technical Information Test Reports and Process Specifications	Ltr	Mr. Colombo	HMS/JTO:flw
5-8-63	Adapter Ranger Block III Spacecraft to Agena	Ltr	S. C. Himmel	HMS/WJL:jf
5-10-63	Request for Technical Information	Ltr	D. E. Forney	HMS/MCT/RER:jlw
5-16-63	JPL Conference Report No. 311-680	Ltr	S. C. Himmel	HMS/WJL:jf
5-17-63	Weekly List of Scheduled RA-MC Meetings	TWX	D. E. Forney	J. T. Ofer
5-21-63	Ranger Block 3 Spacecraft Weight Status as of 19 May 1963	TWX	D. E. Forney	HMS
5-31-63	JPL Drawing JX 3159074, "Interface JPL-LMSC Back-Up Timer and TV Back-Up Clock Switch	Ltr	D. E. Forney	HMS/GWH/WJL:mdl
5-31-63	Request for Technical Information Ranger Flights	Ltr	D. E. Forney	HMS/JTO:jf
6-4-63	Transmittal of JPL RA-B3 Interface Drwgs.	Ltr	D. E. Forney	HMS/RER:mjn
6-7-63	Current Agenda for 28th Meeting of the RA-MC Fire Tracting Panel	TWX	V. W. Hammond	M. S. Johnson
6-19-63	Ranger Block 3 Spacecraft Weight Status as of 18 June 63	TWX	D. E. Forney	HMS
6-20-63	Transmittal of Cover, Ranger Block III Spacecraft Design Specifications	Ltr	J. F. Stone	HMS/JTO:mdl
6-20-63	Dynamic Flight Instrumentation of RA 1-5	Ltr	D. E. Forney	HMS/APB/SRS:mdl
6-24-63	Ranger Interface Testing	Ltr	D. E. Forney	HMS/FAG/DSS:jf

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS
6-28-63	Transmittal of Ranger Block III Spacecraft Design Specifications	Ltr	S. C. Himmel	HMS/JTO:jf
7-2-63	Proposed Trip to LMSC	TWX	D. E. Forney	HMS
7-9-63	Launch Vehicle/Spacecraft Integration Document for Ranger IV	Ltr	S. C. Himmel	HMS/GWH/DJS:jf
7-11-63	Dates for Match-Mate Tests of Ranger Block III Spacecraft	Ltr	S. C. Himmel	HMS/WJL/DJS:jf
7-11-63	Dates for Match-Mate Tests of Ranger Block III Spacecraft	Ltr	S. C. Himmel	HMS/WJL/DJS:hf
7-12-63	Transmittal of Unclassififed JPL RA-B3 Interface Drawings	Ltr	D. E. Forney	HMS/RER:bf
7-15-63	Position of TV Test Lights	IOM	D. Kindt	WJL:jf
7-16-63	Ranger Block 3 Spacecraft Weight Status as of 15 July 63	TWX	D. E. Forney	HMS
7-16-63	Request for The Use of An Atlas Telemeter Set	Ltr	W. F. Kindt	HMS/WJL/DJS:jf
7-19-63	Angular Rates of Spacecraft at Separation	Ltr	S. C. Himmel	HMS/WJL/DJS:jf
7-22-63	Telephone Service Request	IOM	H. J. Margraf	WJL/SQS/JS:js
7-24-63	Ranger III Launch Months	TWX	S. C. Himmel	HMS
7-24-63	Transmittal of Ranger Block III Spacecraft Design Specifications	Ltr	S. C. Himmel	HMS/JTO:js
7-26-63	JPL Analysis Documents No. Sal.00.20 and No. STl.09.20	Ltr	D. E. Forney	HMS/WJC/JJL/SRS:mdl
7-26-63	Static Deflections-Ranger Block III Spacecraft	Ltr	D. E. Forney	HMS/WJC/WJL/SRS:mdl
7-29-63	Request for LMSC Ranger Block III Drawings	Ltr	D. E. Forney	HMS/JTO/RER:js
7-29-63	Revision of Instrumentation for Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:bf
7-31-63	JPL Report No. Stl.00.20 and Memo on Transportation Criteria	Ltr	D. E. Forney	HMS/WJC/WJL/SRS:js
8-2-63	Status of Atlas/Agena Propellant Reserves for Block III Rangers Contract NAS3-3800	TWX	S. C. Himmel	HMS
8-6-63	Request for Drawings	TWX	D. E. Forney	J. T. Ofer
8-6-63	Instrumentation Requirements for Static Tests	Ltr	S. C. Himmel	HMS/WJL:jf

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS
8-6-63	Transmittal of Drawings	Ltr	D. E. Forney	HMS/WJL:jf
8-6-63	Meeting Prior to Match-Mate Tests of RA-6	Ltr	D. E. Forney	HMS/WJL:jf
8-6-63	Meeting for Pre-Match-Mate Tests of RA-6	IOM	Distribution	WJL:jf
8-9-63	Transmittal of Unclassified JPL Ranger Block III Interface Drawing	Ltr	D. E. Forney	HMS/RER:vp
8-15-63	Request for Confidential LMSC Document	Ltr	D. E. Forney	HMS/JTO/RER:jf
8-19-63	Additional Loading Conditions for Static Test Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:jf
8-16-63	Revised Dates for Match-Mate Tests for the Ranger 6 Spacecraft	Ltr	S. C. Himmel	HMS/WJL:bf
8-19-63	Proposed Block III Supplymentary AGE-E Instrumentation	IOM	A. P. Bowman	WJL:jf
8-22-63	Weight and CG Estimates	TWX	D. E. Forney	HMS
8-22-63	Request for Extra Sets of Hardware	TWX	D. E. Forney	HMS
8-23-63	Information of Ranger Block III Adapter	TWX	D. E. Forney	HMS
8-27-63	Ranger Adapter Spacecraft Supports	TWX	S. C. Himmel	HMS
8-29-63	Separation Tests for RA-6	TWX	S. C. Himmel	HMS
9-3-63	Coordination of Interface Drawings, Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:jf
9-5-63	Preload Shim Height, RA-6 and Adapter No. 6008	Ltr	D. E. Forney	HMS/WJL:jf
9-6-63	JPL Engineering Planning Document No. 168	Ltr	D. E. Forney	HMS/JSR/DJS:mdl
9-6-63	Request for Unclassified LMSC Drawings	Ltr	D. E. Forney	HMS/AH/RER:jf
9-11-63	LMSC System Test Objective Document for Ranger Block III	TWX	S. C. Himmel	HMS
9-13-63	JPL Engineering Planning Document No. 78 Rev. 1	Ltr	D. E. Forney	HMS/PJR/JTO:bj
9-13-63	Photographs-RA-6 and Agena Adapter and Shroud Match-Mate Tests	Ltr	S. C. Himmel	HMS/WJL:jf
9-13-63	Transmittal of Ranger Block III Spacecraft Design Specifications	Ltr	S. C. Himmel	HMS/JTO:jf

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS
9-13-63	Match-Mate Tests RA-7	TWX	S. C. Himmel	HMS
9-16-63	Transmittal of JPL Documents to LMSC	Ltr	D. E. Forney	HMS/WJL:jf
9-19-63	Transmittal of Unclassified Ranger Block III Drawings	Ltr	D. E. Forney	HMS
9-20-63	Request for Agena Vehicle 6008 Drawings	Ltr	D. E. Forney	HMS/WJL/RER:jf
9-20-63	Instrumentation Requirements for Ranger Static Tests	TWX	S. C. Himmel	HMS
9-24-63	Ring Support Fixture for Ranger Spacecraft	TWX	D. E. Forney	HMS
9-30-63	Transmittal of JPL Report No. STl.01.20 Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:jf
10-2-63	Transmittal of Match-Mate Report for RA-6	Ltr	S. C. Himmel	HMS/WJL:jf
10-2-63	Request for Agena Antenna	TWX	S. C. Himmel	HMS
10-4-63	Transmittal of JPL Specification "Lunar Impact Creiteria", Ranger Block III	Ltr	D. E. Forney	HMS/JTO:jf
10-4-63	Change in Back-Up Timer Bracet for Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:jf
10-8-63	Transmittal of Ranger Spacecraft Static Test Data Sheets	Ltr	D. E. Forney	HMS/WJL:br
10-8-63	Transmittal of Ranger Block III Spacecraft Design Specifications	Ltr	S. C. Himmel	HMS/JTO:jf
10-8-63	Action Items Developed by RA-6 Match-Mate Tests-Present Status and Supplementary Information	Ltr	S. C. Himmel	HMS/WJL:jf
10-8-63	Transmittal of "Ranger Block III Trajectory Lunar Impact Criteria", JPL Specifications RC)-50012 DSN, 25 July 1963	Ltr	S. C. Himmel	HMS/JTO:jf
10-11-63	Transmittal of Ranger Decals	Ltr	R. S. Campbell	HMS/MP/JTO:br
10-16-63	Preload Shim Height, Ranger Block III Test Spacecraft Bus and LMSC Test Adapter	Ltr	D. E. Forney	HMS/WJL:br
10-16-63	Transmittal of JPL Conference Report No. 311-695 RA-7 Pre-Match Mate Meeting	Ltr	S. C. Himmel	HMS/JTO:br
10-22-63	Ranger Block III Weight-CG-and Inertia Status as of 18 Oct 1963	TWX	D. E. Forney	HMS
10-22-63	Lear Seigler Study RA-6 Probability of Success	TWX	D. E. Forney	HMS
10-23-63	Conference on Test Results for Ranger Block III	TWX	D. S. Himmel	HMS
10-23-63	Revision of Ranger Block III Launch Schedule	TWX	H. N. Levy	HMS
10-24-63	Vibration Measurement in Spacecraft	IOM	Distribution	WJL:jf
10-24-63	Request for the Temporary Use of a Flight Type FFS-16 Radar Transponder	Ltr	S. C. Himmel	HMS/WJL:br
10-31-63	Photographs RA-7 Agena Adapter & Shroud Match Mate Tests	Ltr	S. C. Himmel	HMS/WJL:jf
11-1-63	JPL Engineering Planning Document No. 131	Ltr	D. E. Forney	JNJ/JSR:br
11-4-63	Request for RF Equipment	TWX	S. C. Himmel	HMS
11-5-63	Transmittal of Copies of JPL Test Report, STl.00.23	Ltr	S. C. Himmel	HMS/WJL:br
11-7-63	Revised JPL Spec. for Vehicle System Integration; Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:bro
11-8-63	Transmittal of JPL Documents as requested in Subject References	Ltr	Lear Siegler	HMS/JRO:br
11-8-63	List of Launch Vehicle/Spacecraft Interface Action Items for Ranger Project, Block III	Ltr	S. C. Himmel	HMS/JTO:br
11-11-63	Ranger Spacecraft Design Specifications	Ltr	D. C. Sheppard	HMS/JTO:br
11-12-63	Request for LMSC Reports	TWX	S. C. Himmel	HMS
11-14-63	Spacecraft Back-Up Timer for Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:br
11-18-63	Request for Change in Telemetry Measurement for Ranger Block III	Ltr	S. C. Himmel	HMS/WJL:jf
11-19-63	Systems Test Objectives for Ranger Block III	TWX	S. C. Himmel	HMS
11-21-63	JPL is in Urgent Need of the following LMSC Documents for Ranger Block III Flight Instrumentation Evaluation	TWX	D. E. Forney	HMS
11-22-63	List of Launch Vehicle/Spacecraft Interface Action Item for Ranger Block III	Ltr	S. C. Himmel	HMS/JTO:br

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS
11-26-63	Ranger Block III Weight-CG-and Inertia Status as of 15 November 1963	TWX	D. E. Forney	HMS
12-2-63	Transmittal of Ranger Block III Spacecraft Design Specifications	Ltr	S. C. Himmel	HMS/JTO:br
12-2-63	Schedule for RA-8 and RA-9 Match-Mate Tests	Ltr	S. C. Himmel	HMS/WJL:br
12-2-63	Request for Quotation on RF Equipment	TWX	D. E. Forney	HMS
12-3-63	Ranger Block III Hardware Identification	IOM	Distribution	WJL:jf
12-3-63	Ranger Block III Request for Radar Transponder	TWX	S. C. Himmel	HTL
12-3-63	Tradewinds Cooling Sheath, Removal Time	Ltr	S. C. Himmel	HMS/WJL:jf
12-3-63	Ranger Block V	TWX	D. E. Forney	G. Robillard
12-9-63	JPL Engineering Planning Document No. 130, Addendum No. 1	Ltr	D. E. Forney	HMS/JRS/DJS:br
12-11-63	Weight Components of Ranger Block III Spacecraft	Ltr	S. C. Himmel	HMS/IMcW:jf
12-13-63	Erata, JPL Engineering Planning Document No. 168	Ltr	D. E. Forney	HMS/JSR:br
12-13-63	Transmittal of JPL Addendum No. 1 EPD 130	Ltr	Lear Siegler, Inc.	HMS/JTO:br
12-16-63	Transmittal of Unclassified JPL Ranger Block III	Ltr	D. E. Forney	HMS/JTO/RER:bf
12-16-63	Modification of Ranger/Agena Adapter 6006 to Flight Con	TWX	D. E. Forney	HMS
12-18-63	JPL Engineering Planning Document No. 78 Revision 2	Ltr	S. C. Himmel	HMS/JTO:br
12-18-63	Ranger Block III Weight-GC-and Inertia Status as of 15 December 1963	TWX	D. E. Forney	HMS
12-23-63	Request for Data	Ltr	S. C. Himmel	HMS/WJL:jf
12-26-63	Ranger Block III Separation System Performance	TWX	S. C. Himmel	HMS
12-30-63	Ranger Block III Drawings	Ltr	D. E. Forney	HMS/WJL:jf
12-30-63	Trip Report to AMR 10-12- December 1963	IOM	H. J. Margraf	WJL:jf

RANGER LAUNCH VEHICLE INTEGRATION

OUTGOING DOCUMENTS LIST

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS	LV No.
1-3-64	Proposed Revision to LMSC/A057-758-B	TWX		HMS/JTO:br	
1-6-64	Report for Ranger Project Meeting	IOM	H.J.M.	WJL	
1-8-64	Instrum. Drwgs for RA	TWX		HMS/	127
1-7-64	LMSC Letter A377820	IOM	A. B	WJL	
1-9-64	S/C Adapter Contamination	Ltr	Himmel	HMS/WJL/br	00020
1-9-64	Change in Spec RO)-30947-DTL-C	IOM	G. Voelker	WJL	
1-10-64	Ltr 00020 (WJL)	IOM	McGee	WJL:jf	90001
1-9-64	Vibrational Testing of Spacecraft	Ltr	Himmel	HMS/WJL:jf	
1-15-64	Veh S/C Action Items	Ltr	Himmel	HMS/JTO:br	90010
1-15-64	EPD-193	Ltr	Himmel	HMS/JSR:br	90015
1-15-64	EPD-130, Adden. #2	Ltr	Himmel	HMS/JSR:br	90016
1-21-64	RA Blk III Contract NAS 3-3800	TWX	Himmel	HMS/	152
1-21-64	Req. for Tech. Info	TWX	Himmel	HMS/JTO/RR:br	90021
1-21-64	Req. for Tech. Info	Ltr	Himmel	HMS/MAP:br	90025
1-22-64	Transmittal Docs.	Ltr	Jean Siegle	HMS/JTO:br	90029
1-22-64	RA Blk III Weight	TWX	Himmel	HMS/WJL:br	90030
1-22-64	Evaluation of Cold Cloud	Ltr	Himmel	HMS/JSR:jn	
1-23-64	Req. for LMSC Doc	TWX	Himmel	HMS/JTO:br	90034
1-23-64	Req. for LMSC Doc	TWX	Himmel	HMS/JTO:br	90035
1-28-64	Prop. Ball Band Coop. Spec. Change	TWX	Himmel	HMS/WJL:	90043
1-29-64	RA-6 Mis. Postflt Anal. Present.	TWX	Himmel	HMS/JTO:br	90046
1-30-64	Trans of Specs	Ltr	Himmel	HMS/JTO:br	90048
1-30-64	Trans of RA Blk III Drwgs.	Ltr	Forney	HMS/WJL/RR:br	90051
1-31-64	S/C Dummy Run	TWX	Himmel	HMS/SJL:br	90055
2-3-64	Confirm. of RA Postflt Present	TWX	Himmel	HMS/MAP:jf	90058

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS	LV No.
2-4-64	Loan C-Band	TWX	Himmel	HMS/WJL:br	90063
2-4-64	M/M & Drw for RA 8	IOM	Distb	WJL/bf	90046
2-5-64	Pre-release Prints	Ltr	Armistead	HMS/JTO:br	90065
2-5-64	S/C Dummy Run for RA 8 & 9	Ltr	Himmel	HMS/WJL/DS:bf	90066
2-5-64	Req. for RA 6 Data	TWX	Forney	HMS/JTO:jf	90067
2-6-64	Shroud Ejection	TWX	Himmel	HMS/WJL:bf	90068
2-11-64	Req. for Data Red Anoly	TWX	Himmel	HMS/WJL:jf	90073
2-14-64	LV/S/C Interface Sched	Ltr	Forney	HMS/JTO:jf	90078
2-18-64	Trans Minutes	Ltr	Himmel	HMS/JTO:br	90085
2-19-64	Prop Base Band Cpler Chng	TWX	Himmel	HMS/WJL:jf	90087
2-19-64	JPL Prel. S/C Opern	Ltr	Nicks	HJM/JTO/DJS:	90088
2-19-64	Req for Data Reduc. & Analys. Dynamic Meas.	TWX	Himmel	HMS/WJL/DS:bf	90090
2-19-64	Instrumentation Chg	TWX	Himmel	HMS/WJL:jf	90091
2-20-64	Weight - Gravity	TWX	Himmel	HMS/WJL:br	90093
2-24-64	Friendly Note	Ltr	A. Nowitsky	WJL	
2-25-64	Req. for Drawings	TWX	Himmel	HMS/WJL:br	90103
2-26-64	Cooling White on Pad	Ltr	Himmel	HMS/WJL:jf	90105
2-26-64	Spring Rates	TWX	Himmel	HMS/WJL:jf	90106
2-27-64	Amend. to Spec.	Ltr	Himmel	HMS/WJL:br	90108
2-28-64	Action Items	Ltr	Himmel	HMS/JTO:br	90111
3-5-64	Req for Dwgs	TWX	Forney	HMS/WJL/RER:br	90118
3-5-64	Sched dates for RA-9 MM Tests	TWX	Himmel	HMS/WJL:jf	90119
3-9-64	Data Reduction RA-6	TWX	Himmel	HMS/WJL:bf	90122
3-9-64	RA-6 DataPresentation Meeting	IOM	Dist.	WJL	
3-9-64	Baseland Coupler	TWX	Himmel	HMS/WJL:bf	90124
3-10-64	Transm. of Dwg B J-3180151	Ltr	Forney	HJM:jf	90128
3-11-64	Ackment of Dwgs	Ltr	Forney	HJM:jf	90129
3-12-64	Spg rates RA-8 6006	TWX	Himmel	HMS/WJL:br	90134

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS	LV NO.
3-13-64	Data Presentation Ra-6	IOM	Distb	WJL:jf	90139
3-13-64	Flt Instrumentation	TWX	Himmel	HMS/WJL:jf	90140
3-16-64	Trans RA-8	Ltr	Himmel	HMS/WJL:br	90143
3-16-64	Req and Rec Dwgs	Ltr	Forney	HJM/RR:br	90144
3-17-64	Weights	TWX	Himmel	HMS/WJL:br	90146
3-23-64	Telemetry Measurements	Ltr	Himmel	HMS/WJL:br	90150
3-25-64	Spring Rates Diff	IOM	Distb	WJL:jf	90155
3-25-64	Trans of JPL Doc Blk III	Ltr	O. Nicks	HMS/WJL:br	90157
3-30-64	Labeling of Test Hardware	IOM	T. Bickler	WJL	
3-31-64	Repeat Tests -RA 8	TWX	Himmel	HMS/WJL:br	90160
3-31-64	Spring Rate Constant - 8	Ltr	Himmel	HMS/WJL:br	90161
4-1-64	Req for Infor.	Ltr	Himmel	HMS/MAP:jf	90163
4-1-64	Corona Investig. made	IOM	Distb	MAP/DS:bf	90164
4-8-64	Req. for Meas.	Ltr	Himmel	HMS/WJL:br	90175
4-9-64	Repeat Spring Rate	IOM	J. Long	WJL:jf	90178
4-9-64	RA-7 Booster Vehicles	IOM	HMS	WJL:jf	90179
4-15-64	Transm. EPD-212	Ltr	Himmel	JNJ/RAW:jf	90188
4-16-64	RA-3 Wt-CG & inertia Status	TWX	Himmel	HMS/WJL:br	90190
4-22-64	Transm. Spec.	Ltr	Himmel	HMS/br	90203
4-22-64	Transm. EPD-211	Ltr	Himmel	HMS/RAW:br	90205
5-5-64	Elec. Charge	IOM	Schurmeier	MAP:br	90220
5-6-64	Launch Schedule	TWX	Himmel	HMS	
5-8-64	Pict. of flt adapter & shroud	IOM	Geo. White JPL/AMR	WJL:jf	90230
5-8-64	Use of Agena 6006/Ra7	TWX	Himmel	HMS/WJL:jf	90232
5-11-64	Adapter — door	IOM	Schurmeier	MAP/DS:br	90235
5-14-64	Step Force Test Data	Ltr	Himmel	HMS/WJL:jf	90241
5-15-64	Study Pos Cont frm Atlas Retro-rockets	TWX	Himmel	HMS/	90246

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS	LV No.
5-18-64	Result of Spg Test Constant	Ltr	Himmel	HMS/WJL:jf	90251
5-19-64	JPL P/FR's	Ltr	Himmel	HMS/WJL:jf	90257
5-20-64	Weh. Int. Act. Items	Ltr	Himmel	HMS/JTO:br	90259
5-20-64	Review P. R. Dwg	Ltr	Himmel	HMS/WJL:br	90260
5-20-64	RA Blk III Wt	TWX	Himmel	HMS/WJL/DS:bf	90261
5-20-64	Trans EPD 213	Ltr	Himmel	HMS/RAW:br	90262
5-21-64	SSD Mtg-Atlas Autopilot transpr.	IOM	Distb.	MAP:jf	90271
5-22-64	Dyn. Msmts. Gimbol	IOM	H. Levy	WJL:jf	90273
5-28-64	Elec. Test at JPL	TWX	Himmel	HMS/WL:bf	90286
6-3-64	Status of GE Vib. Tests	IOM	Schurmeier	WJL/jf	90293
6-3-64	Verifica of Dyn Flt Data	Ltr	Himmel	HMS/WJL:jf	90294
6-3-64	Req. for Atlas Films	Ltr	Himmel	HMS/WJL:br	90295
6-3-64	Rewk of Junc. boxumbilic. twr	Ltr	Himmel	HMS/WJL:jf	90296
6-4-64	High Voltage Tests	IOM	Distb.	MAP:jf	90298
6-5-64	Prop Rev to LMSC	Ltr	Himmel	HSS/JTO:br	90300
6-5-64	Req. Addt'l Camera	IOM	Stavros	WJL:jf	90301
6-8-64	Status-Ra invest launch/inj. environs.	IOM	Schurmeier	MAP:jf	90305
6-8-64	Rngr Proj. Review	TWX	Himmel	WJL/HMS:jf	90306
6-8-64	Eng. Plan Doc 78	Ltr	Himmel	HMS/JTO:br	90307
6-8-64	EPD 207	Ltr	Himmel	HMS/JTO:br	90308
6-10-64	Disc & Analysis-Hi volt-RCA test	IOM	Distr.	MAP:jf	90314
6-15-64	Static Charges	IOM	Distr.	MAP:br	90318
6-16-64	RA III Weights	TWX	Himmel	HMS/WJL:br	90320
6-17-64	Trans. Docs.	Ltr	Himmel	HMS/JTO:br	90323
6-17-64	Analysis of Hi-voltage & RCA test results	IOM	Schurmeier	MAP:jf	90325
6-17-64	Req. NASA badges	Ltr	Rovenger	TJP/LSB:br	90326
6-19-64	AMR tracking Req. for RAnger 7	TWX		HMS/	0742
6-22-64	Req. GDA Docs	TWX	Himmel	HMS/JTO:br	90332
6-19-64	Req. Permission to Launch RA-7	Ltr	H. W. C.	HMS/	
6-23-64	PD16-Trans-RA III	Ltr	Himmel	HMS/RAW:br	90334
6-25-64	Request for LMSC Report on RA-6	IOM	D. Wiksten	J. T. Ofer	
6-25-64	Presenta. of Ra Investig.	IOM	Distr.	MAP:jf	90344
6-29-64	Return of Secret Document	Ltr	F. Brook	HMS/JTO/RER:br	90350
6-26-64	RA-7 STO	TWX	P. Barnum/ JPL/AMR	JTO/	90351
6-30-64	PD-18 RA Blk III	Ltr	Himmel	HMS/EST:br	90361
7-1-64	Shim Thickness to provide thickness on S/C	TWX	Himmel	HMS/WL:br	90362
7-8-64	Trans. EPD-78 RA 6	Ltr	Himmel	HMS/JTO:br	90374
7-9-64	Transm of JPL Doc. RA 6	Ltr	Wood-Martin Co.	HJM/JAP:jf	90376
6-14-64	Config. PD-16 RA III	Ltr	Himmel	HMS/RAW:br	90379
7-15-64	Add #1 PD-18 RA III	Ltr	Himmel	HMS/EST:br	90386
7-16-64	Wt C-G Inertia RA III	TWX	Himmel	HMS/WJL:jf	90387
7-16-64	LMSC Intface Dwg List III	IOM	Distr	WJL:jf	90388
7-17-64	Atlas-AGE Elec Trans	TWX	Himmel	HMS/WJL:jf	90391
7-17-64	PD #20 RA B	Ltr	Himmel	HMS/DJS:bf	90392
7-17-64	Verif. Dyn. Flt. Data RA 8-9	TWX	Himmel	HMS/WJL:jf	90393
7-21-64	Trans S/C Specs	Ltr	Himmel	HMS/JTO:bf	90397
7-22-64	Postflt Analy Present. -RA 7	TWX	Cunningham/ Himmel	HMS/WJL:jf	90402
7-24-64	Trans Minutes	Ltr	Himmel	HMS/JTO:br	90409
7-31-64	RA 7 Launch data Tape A002	TWX	Himmel	HMS/WL:bf	90421
8-3-64	M/M Sched. Dates 8 & 9	TWX	Himmel	HMS/WJL:jf	90428
8-6-64	Moon Pictures	IOM	R. Wilford	SRS/CMA:br	90433
8-6-64	LMSC Dwgs	TWX	Forney	HMS/RER:br	90435
8-11-64	Trans. Diags.	Ltr	Forney	HMS/RER:br	90441

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS	LV No.
8-11-64	Trans Specs	Ltr	Himmel	HMS/DJS:br	90442
8-14-64	Motion Pict. SIC Umb. Plug RA 6-7 Pullout	IOM	E. DeView	WJL:jf	90452
8-19-64	Wt-CG Inertia	TWX	Himmel	HMS/WJL:pr	90461
8-20-64	Ret of Secret Film	Ltr(S)	Eyerman GD/A	HJM/DJS:bf	90463
8-28-64	Info to France RA-7	Ltr	Giami	MAP:bf	90480
9-4-64	Trans RA-7 Postflt Analys	Ltr	Himmel	HMS/WJL:jf	90495
8-4-64	Trans Vu-Graph Photos	Ltr	Mercer, LMS	HJM/WJL:bf	90406
9-8-64	Firing Sched.	TWX	Himmel	WJL/HMS:jf	90499
9-9-64	Mtg - Dyn Flt Data	TWX	Himmel	WJL/HMS:jf	90500
9-16-64	S/C Weight	TWX	Himmel	HMS/WJL:jf	90508
9-17-64	Dates for M/M tests	TWX	Himmel	HMS/WJL:jf	90509
9-18-64	Mtg Rpt - Dyn Ver	IOM	Margraf	WJL:jf	90516
9-22-64	Trans. Drw. J-315-6400	Ltr	Himmel	HMS/DS:bf	90524
9-24-64	Release Blk III Flts	Ltr	Swartz, Snyvle	HMS/DS:bf	90528
9-29-64	Dates - M/M 8 and 9	TWX	Himmel	HMS/DJS:bf	90537
9-30-64	Trans. Agena/Ranger Adapter	Ltr	Himmel	HMS/DS:bf	90540
10-5-64	Trans. PD-19	Ltr	Himmel	HMS/DS:bj	90545
10-5-64	Agena Instr For RA	Ltr	Himmel	HMS/DS:jf	90546
10-8-64	Eval-test Smry Rpt	IOM	Sweetnam	WJL/DS:jf	90548
10-13-64	Amend to Dsn Spec	Ltr	Himmel	HMS/RAW:jf	90555
10-19-64	Wt, CG & Inertia	TWX	Himmel	HMS/WJL:jf	90564
10-22-64	Transm - Specs	Ltr	Himmel	HMS/WJL:jf	90575
10-22-64	Transm. of EPD-242	Ltr	Himmel	HMS/WJL:jf	90576
10-23-64	Re-M/M S/C tests	IOM	Distrb	WJL:jf	90581
10-28-64	L/V Report	IOM	Schienle	WJL:jf	90587
11-3-64	Trans of Blk III Top	Ltr	Himmel	HMS/WJL:jf	90595

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS	LV No.
11-6-64	Req for LMSC Doc	Ltr	Himmel	HJM/DS:jf	90601
11-9-64	Photog R Missile Flt	TWX	AFETC Hq.	HMS/WJL:jf	90605
11-12-64	Spr Constant Results	Ltr	Himmel	HMS/WJL:jf	90610
11-11-64	End-End Calibration	TWX	Himmel	HMS	--
11-13-64	RA Umbilical Cables	TWX	Himmel	HMS/WL:bf	90613
11-16-64	RA Blk III Wt - CG Inertia Status	TWX	Himmel	HMS/	90615
11-17-64	Trans of Grnd Eng Dwg	TWX	Himmel	HMS/WJL/TM:jf	90616
11-19-64	Fol--up Act Dyn Data	IOM	Nichols	WJL:jf	90617
11-24-64	Surv of autopilot transf	Ltr	Himmel	HMS/WJL:jf	90623
11-24-64	Status Rpt	IOM	Schienle	WJL:jf	90624
11-30-64	Trans of Spec	Ltr	Himmel	HMS/WJL:jf	90628
12-3-64	Dyn. Msrmts.	IOM	Levy	WJL:jf	90631
12-8-64	M/M Tests for RA 9	IOM	Distr	WJL:jf	90636
12-9-64	Trns Memo RA 8 M/M	Ltr	Himmel	HMS/WJL:jf	90638
12-9-64	Trnas of Proc 3R10201	Ltr	Himmel	HMS/WJL:jf	90639
12-11-64	Mtg Accel Calibration	TWX	Forney	HMS/WJL:jf	90644
12-14-64	Action Item List	Ltr	Himmel	HMS/WJL:jf	90649
12-16-64	Wt CG & Inertia Status	TWX	Himmel	HMS/WJL:jf	90651
12-16-64	LV Rpt to RA Proj Mtg	IOM	Schurmeier	WJL:jf	90652
12-17-64	G.E. Guid. System	Ltr	Himmel	HMS/WJL:jf	90653
12-18-64	On Pad Lnch Temp Control	Ltr	Himmel	HMS/WJL:bf	90655
12-22-64	Req for Doc	Ltr	Himmel	HMS/RER:jf	90656
12-22-64	M/M & S/C Test Util RA 9	IOM	Distrb.	WJL:jf	90657
12-28-64	Acctblty RA Hardware	IOM	HJM & Distb	WJL:bf	90662
12-28-64	End-to-End Calibration RA 8-9 acceleration & Vibration System	IOM	Shoenhair	HMS/	—

SENT DATE	SUBJECT	TYPE	SENT TO	INITIALS	LV No.
1-5-65	Req. for Tech. Info -RA III	Ltr	Himmel	HMS/WJL/RER:jk	90669
1-5-65	Transfer of Acct Hdwr	IOM	Hussey	WJL:bf	90670
1-6-65	RF Hdline Monitor RA 8-9	TWX	Himmel	HMS/WJL:bf	90671
1-8-65	Status Report	IOM	Schienle	WJL:br	90676
1-8-65	Trans. JPL Ranger Dwgs.	Ltr	Himmel	HMS/RR:br	90677
1-14-65	Transm EPD 78, Rev 5, RA 8-9	Ltr	Cunningham	HMS/WJL:jf	90689
1-18-65	Request for RA Blk III Technical	Ltr	Himmel	HMS/WJL/RER:jk	90692
1-19-65	Orientation of Accel Ra 9	Ltr	Himmel	HMS/WJL:jf	90693
1-19-65	Errata to Mins RA 7 Postflt Analys. Meet	Ltr	Himmel	HMS/WJL:jf	90695
1-19-65	LV Status as of 1-19-65	IOM	Schienle	WJL:jf	90696
1-20-65	Trans of PD-28	Ltr	Cunningham	HMS/WJL:jf	90698
1-25-65	Test Srng Const Results	Ltr	Himmel	HMS/WJL:jf	90706
1-25-65	Veh 6006 Accept. Rpt	IOM	Schurmeier	MAP:jf	90707
1-25-65	Trans of Rev to TOP	Ltr	Himmel	HMS/WJL:jf	90708
1-27-65	Wt CG	TWX	Himmel	HMS/WJL:jf	90713
1-29-65	Trans of Drwgs	Ltr	Schurmeier	HMS/TCM/RER:bf	90718
2-5-65	Req for Tech Info	Ltr	Himmel	HMS/WJL/RER:jf	90734
2-8-65	Errata Sht f/EPD-242	Ltr	Cunningham	HMS/WJL:jf	90735
2-10-65	Trans. Adden. to PD-18	Ltr	Cunningham	HMS/WJL:jf	90741
2-10-65	Trans PD-19	Ltr	Cunningham	HMS/WJL:jf	90742
2-12-65	Ctdwns Seq. Events RA C	IOM	Distrb	WJL;jf	90746
2-15-65	Wt, CG	TWX	Himmel	WJL/DS:jf	90747
2-15-65	Trans of PD-34	Ltr	Cunningham	WJL/DS:jf	90748
2-16-65	Trans of Specs	Ltr	Cunningham	WJL/jf	90749
3-2-65	Storage of EM 550 A	IOM	Hussey	WJL:jf	90753
3-3-65	Trans of Rev 2 to TOP	Ltr	Bode	HM/WJL:jf	90756
3-9-65	Trans of Add 3 to PD-18	Ltr	Cunningham	HMS/WJL:jf	90758
3-15-65	Trans of PD-39	Ltr	Cunningham	HMS/WJL:jf	90764
3-18-65	Wt, CG, Inertia	TWX	Himmel	WJL/HMS:jf	90767
3-25-65	Trans RA PD-40	Ltr	Cunningham	HMS/DJL/DS:bf	90778
3-26-65	Rev 3 to TOP	Ltr	Bode	HJM/WJL:jf	90782
3-29-65	Pic of RA 9 Flt Data	TWX	Himmel	WJL:bf	90786
4-5-65	Trans of Postflt Dwg RA 8	Ltr	Cunningham	HMS/WJL;jf	90796
4-21-65	Recom. for Future Proj.	IOM	Schurmeier	WJL:jf	90813
4-27-65	End-to-End Calib Tapes for RA-D RA-IX	TWX	Himmel	HMS/WJL:bf	90817
5-14-65	Transmittal of Ranger Documents	Ltr	Himmel	RJP/WJL:jf	90822

APPENDIX H

RANGER CLASSIFIED DOCUMENTS

All of the classified documents for the Launch Vehicle Integration Section are kept separately at one of the JPL Classified Document Control Points. The custodian's list of this classified material for the Ranger Program constitutes Appendix H.

GDC AE-60-1005 Confidential

"INSTRUMENTATION SUMMARY PGIA AGENA ATLAS SPACE BOOSTER AT AMR", (U)

Dated 3 February 1961

GDC AE-61-0640 Secret

"FLIGHT TEST EVALUATION REPORT MISSILE 111D", (U)

Dated 14 September 1961

LMSC 370962 Confidential

"TECHNICAL REQUIREMENTS OF THE ATLAS/AGENA ASCENT GUIDANCE EQUATIONS FOR NASA LUNAR MISSIONS RA-I THROUGH RA-V", (U)

Dated 27 October 1960

LMSC 376493 Confidential

"RANGER SYSTEM OPERATION PLAN - RA-I THROUGH RA-V", (U)

Dated 29 May 1961

LMSC 379892 Confidential

"THERMODYNAMICS DEPARTMENT INPUT FOR SS/A ENGINEERING ANALYSIS REPORT NASA VEHICLES 10205 AND 6001 ", (U) RA-I AND RA-II.

Dated 9 January 1961

LMSC 448617-01 Secret

"RANGER I SYSTEM TEST EVALUATION AND PERFORMANCE ANALYSIS REPORT (35-DAY REPORT)", (U)

Dated 27 September 1961

LMSC A098222 Confidential

"PRELIMINARY FLIGHT INFORMATION, RA-I", (U)

Dated 23 August 1961

LMSC A099738 Confidential

"THERMODYNAMICS INPUT TO 35DAY REPORT ON RANGER 10205-6001", (U)

Dated 7 September 1961

STL 9321.4-170 Confidential

"RANGER I ASCENT GUIDANCE, POST FLIGHT REPORT", (U)

Dated 11 October 1961

JPL EPD NO. 13 (Rev. 2) Confidential

"LMSD - JPL INTERFACE PLAN OF OPERATIONS ATLAS - AGENA VEHICLES 6001 THROUGH 6005 (RANGER SPACE - CRAFT RA-I THROUGH RA-V)", (U)

Dated 29 May 1961

JPL SPEC. NO. 30331A Confidential

"VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT A-I THROUGH A-V", (U)

Dated 6 June 1960

JPL SPEC. NO. 30331 (Change B) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 18 January 1961

JPL SPEC. NO. 30331 (Rev. C) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 5 August 1961

GDC AE-61-0884 Secret

"FLIGHT TEST EVALUATION REPORT MISSILE 117D", (U)

Dated 27 December 1961

LMSC 370962 Confidential

"TECHNICAL REQUIREMENTS OF THE ATLAS/AGENA ASCENT GUIDANCE EQUATIONS FOR NASA LUNAR MISSIONS RA-I THROUGH RA-V", (U)

LMSC 376493 Confidential

"RANGER SYSTEM OPERATION PLAN - RA-I THROUGH RA-V", (U)

Dated 29 May 1961

LMSC 379892 Confidential

"THERMODYNAMICS DEPARTMENT INPUT FOR SS/A ENGINEERING ANALYSIS REPORT NASA VEHICLES 10205 AND 6001 - RA-I AND RA-II", (U)

Dated 9 January 1961

LMSC 448617-02 (and Addendum) Secret

"RANGER II SYSTEM TEST EVALUATION AND PERFORMANCE ANALYSIS REPORT (35-DAY REPORT)", (U)

Dated 23 December 1961

LMSC 448678 Secret

"RANGER RANGE SAFETY ANALYSIS AND TRAJECTORY REPORT FLIGHT RA-II", (U)

Dated 29 September 1961

LMSC A070077 Confidential

"THERMODYNAMICS INPUT TO 35-DAY REPORT ON RANGER 10205-6002", (U)

Dated 7 December 1961

JPL EPD NO. 13 (Rev. 2) Confidential

"LMSD - JPL INTERFACE PLAN OF OPERATIONS ATLAS - AGENA VEHICLES 6001 THROUGH 6005 (RANGER SPACE - CRAFT RA-I THROUGH RA-V", (U)

Dated 29 May 1961

JPL SPEC. NO. 30331A Confidential

"VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT A-I THROUGH A-V", (U)

Dated 6 June 1960

JPL SPEC. NO. 30331 (Change B) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 18 January 1961

JPL SPEC. NO. 30331 (Rev. C) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 5 August 1961

GDC AE-61-0885 Secret

"FLIGHT TEST EVALUATION REPORT MISSILE 121D", (U)

Dated 10 April 1962

LMSC SSN-T-62-4 Confidential

"ATLAS/AGENA WORKING GROUP NASA/AGENA B RANGER PROGRAM LAUNCH REPORT FOR ATLAS 121D/AGENA-B 10205-6003 RANGER SPACECRAFT RA-III", (U)

Dated 10 February 1962

LMSC 370962 Confidential

"TECHNICAL REQUIREMENTS OF THE ATLAS/AGENA ASCENT GUIDANCE EQUATIONS FOR NASA LUNAR MISSIONS RA-I THROUGH RA-V", (U)

Dated 27 October 1960

LMSC 376493 Confidential

"RANGER SYSTEM OPERATION PLAN - RA-I THROUGH RA-V", (U)

Dated 29 May 1961

LMSC 385937 Confidential

"RA-III PERFORMANCE CAPABILITY AND MARGIN STATUS", (U)

Dated 28 February 1961

LMSC 448617-03 Secret

"RANGER III SYSTEM TEST EVALUATION AND PERFORMANCE ANALYSIS REPORT (35-DAY REPORT)", (U)

Dated 12 March 1962

LMSC 1314642 Confidential

"SEQUENCE OF EVENTS MODEL 10205 VEHICLE 6003", (U)

Dated 8 August 1961

LMSC A082360 (and Addendum) Confidential

"RANGER AND MARINER ATLAS/AGENA RANGE SAFETY ANALYSIS AND TRAJECTORY REPORT (FLIGHTS RA-III AND SUBSEQUENT)", (U)

Dated 2 January 1962

JPL Confidential

"RANGER/AGENA B PROGRAM RA-III AND RA-IV TRAJECTORY", (U)

Dated 20 September 1961

JPL SPEC. NO. 30331A Confidential

"VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT A-I THROUGH A-V", (U)

Dated 6 June 1960

JPL SPEC. NO. 30331 (Change B) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 18 January 1961

JPL SPEC. NO. 30331 (Rev. C) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 5 August 1961

JPL EPD NO. 13 (Rev. 2) Confidential

"IMSD - JPL INTERFACE PLAN OF OPERATIONS ATLAS - AGENA VEHICLES 6001 THROUGH 6005 (RANGER SPACE - CRAFT RA-I THROUGH RA-V)", (U)

Dated 29 May 1961

<u>SUBJECT MATTER</u> Confidential

"ASPECTS OF SPACECRAFT RANGE SAFETY DESIGN FOR RANGER III, IV AND V", (U)

GDC AE-62-0447 Secret

"FLIGHT TEST EVALUATION REPORT MISSILE 133D", (U)

Dated 18 July 1962

NOTE: JPL Library Document Filed Under Accession No. 111160.

LMSC 271596 Confidential

"ATLAS/AGENA WORKING GROUP NASA/AGENA B RANGER PROGRAM LAUNCH REPORT FOR ATLAS 133D/AGENA-B 10205-6004 RANGER SPACECRAFT RA-IV", (U)

Dated 8 May 1962

LMSC 370962 Confidential

"TECHNICAL REQUIREMENTS OF THE ATLAS/AGENA ASCENT GUIDANCE EQUATIONS FOR NASA LUNAR MISSIONS RA-I THROUGH RA-V", (U)

Dated 27 October 1960

LMSC 376493 Confidential

"RANGER SYSTEM OPERATION PLAN - RA-I THROUGH RA-V", (U)

Dated 29 May 1961

LMSC 448617-04 (and Addendum) Secret

"RANGER IV SYSTEM TEST EVALUATION AND PERFORMANCE ANALYSIS REPORT (35-DAY REPORT)", (U)

Dated 28 May 1962

LMSC 1314643 Confidential

"SEQUENCE OF EVENTS MODEL 10205 VEHICLE 6004", (U)

Dated 16 November 1961

JPL Confidential

"RANGER/AGENA B PROGRAM RA-III AND RA-IV TRAJECTORY", (U)

Dated 20 September 1961

JPL SPEC. NO. 30331A Confidential

"VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT A-I THROUGH A-V", (U)

Dated 6 June 1960

JPL SPEC. NO. 30331 (Change B) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 18 January 1961

JPL SPEC. NO. 30331 (Rev. C) Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 5 August 1961

JPL EPD NO. 13 (Rev. 2) Confidential

"LMSD - JPL INTERFACE PLAN OF OPERATIONS ATLAS - AGENA VEHICLES 6001 THROUGH 6005 (RANGER SPACE - CRAFT RA-I THROUGH RA-V", (U)

Dated 29 May 1961

SUBJECT MATTER

"ASPECTS OF SPACECRAFT RANGE SAFETY DESIGN FOR RANGER III, IV AND V", (U)

GDC AE-60-10005-215 — Confidential

"ATLAS/AGENA-B/RANGER INSTRUMENTATION PLAN SERIES D ARTICLE 215 AMR (RA-V)", (U)

Dated 10 August 1962

GDC AE-62-0521 — Confidential

"ATLAS SPACE BOOSTER FLIGHT TEST PLAN FOR BOOSTER NO. 215D", (U)

Dated 17 June 1962

LMSC 271674 — Confidential

"ATLAS/AGENA WORKING GROUP FLIGHT TEST DIRECTIVE RA-V", (U)

Dated 14 September 1962

LMSC 370962 — Confidential

"TECHNICAL REQUIREMENTS OF THE ATLAS/AGENA ASCENT GUIDANCE EQUATIONS FOR NASA LUNAR MISSIONS RA-I THROUGH RA-V", (U)

LMSC A376149 — Confidential

"UNITS OF VARIANCE DATA FOR RANGER LUNAR MISSION", (U)

Dated 7 June 1963

LMSC 376493 — Confidential

"RANGER SYSTEM OPERATION PLAN - RA-I THROUGH RA-V", (U)

Dated 29 May 1961

LMSC 448617-05 — Secret

"RANGER V SYSTEM TEST EVALUATION AND PERFORMANCE ANALYSIS REPORT (35-DAY REPORT)", (U)

Dated 22 November 1962

LMSC 1314644-D — Confidential

"SEQUENCE OF EVENTS MODEL 10205 VEHICLE 6005", (U)

Dated 16 November 1961

LMSC A047504-A — Confidential

"RANGER SYSTEM TEST OBJECTIVES FLIGHT RA-V", (U)

Dated 10 August 1962

STL 8679-6014-RC000 — Confidential

"RANGER RA-V THIRTY-DAY POST-FLIGHT REPORT", (U)

Dated 13 November 1962

JPL SPEC. NO. 30331A — Confidential

"VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT A-I THROUGH A-V", (U)

Dated 6 June 1960

JPL SPEC. NO. 30331 (Change B) — Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 18 January 1961

JPL SPEC. NO. 30331 (Rev. C) — Confidential

"DETAIL SPECIFICATION VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS FOR RANGER SPACECRAFT RA-I THROUGH RA-V", (U)

Dated 5 August 1961

JPL EPD NO. 13 (Rev. 2) — Confidential

"LMSD - JPL INTERFACE PLAN OF OPERATIONS ATLAS - AGENA VEHICLES 6001 THROUGH 6005 (RANGER SPACE - CRAFT RA-I THROUGH RA-V", (U)

Dated 29 May 1961

SUBJECT MATTER — Confidential

"ASPECTS OF SPACECRAFT RANGE SAFETY DESIGN FOR RANGER III, IV AND V", (U)

AFMTC	Operations Requirements No. 1801 "NASA-RANGER LAUNCH BLOCK III (RA-VI THROUGH RA-IX)", (U) Dated 15 June 1964	Confidential
GDC	AE-62-0520-199 (Rev. A) "LAUNCH VEHICLE (LV-SA) FLIGHT TEST PLAN FOR NO. 199D", (U) - (Rev. A dated 29 December 1963). (LV-3A/S-01/RANGER PROGRAM AT AMR RA-VI). Dated 2 August 1963	Confidential
GDC	BGJ-64-002 "ATLAS SPACE LAUNCH VEHICLE FLIGHT TEST EVALUATION REPORT - 199D", (U) Dated 30 March 1964	Confidential
GE	64-D-200 "EVALUATION REPORT OF MOD IIIA GUIDANCE SYSTEM PERFORMANCE WITH ATLAS-AGENA 199D/6008, RANGER MISSION RA-VI", (U) Dated 1 April 1964	Secret
GE	64-67054 "MOD III PRELIMINARY FLIGHT TEST REPORT", (U) Dated 30 January 1960	Secret
LEAR - SIEGLER	ER-620 "RANGE VI LAUNCH VEHICLE SYSTEM SUCCESS ANALYSIS", (U) Dated 6 March 1964	Secret
LEAR - SIEGLER	ER-620-1 "RANGER VI LAUNCH VEHICLE SYSTEM SUCCESS ANALYSIS ADDENDUM", (U) Dated 16 April 1964	Unclassified

IMSC A602894 Confidential

"MINUTES OF RANGER VI MEETING POST FLIGHT ANALYSIS", (U)

Dated 7 February 1964

IMSC A603322 Confidential

"RANGER VI AGENA VEHICLE 6008 FLIGHT EVALUATION AND PERFORMANCE ANALYSIS REPORT", (U)

Dated 25 March 1964

IMSC A658747 (Vol. I & III) Confidential

"QUICK-LOOK DATA REPORT", (U)
Test No. RA-VI - Vehicle No. 10205-6008.

Dated 12 February 1964

IMSC 1342655-A (and 1342655-B) Confidential

"SEQUENCE OF EVENTS MODEL 10205 VEHICLE 6006", (U)

Dated 13 April 1962

IMSC B040418 Secret

"NASA/ATLAS/AGENA LAUNCH OPERATIONS WORKING GROUP, RANGER VI LAUNCH REPORT", (U)

Dated 19 February 1964

IMSC A057758-C Confidential

"SYSTEM TEST OBJECTIVES FOR RANGER PROJECT FLIGHTS RA-VI THROUGH RA-IX", (U)

Dated 5 September 1963

STL 8679-6046-TC000 Confidential

"RANGER RA-VI THIRTY-DAY POST-FLIGHT REPORT", (U)

Dated 26 February 1964

<u>SUBJECT MATTER</u> Confidential

LAUNCH PERIODS FOR RA-VI
SCHEDULE SLIPS FOR RA-VI
PAYLOAD CAPABILITIES FOR BLOCK III RA-VI
PRINTS AND PHOTOGRAPHS

AFMTC Operations Requirements No. 1801 Confidential

"NASA-RANGER LAUNCH BLOCK III - RA-VI THROUGH RA-IX", (U)

Dated 15 June 1964

GDC AE-62-0520-250 (Rev. A & B) Confidential

"ATLAS SPACE BOOSTER FLIGHT TEST PLAN FOR RA-VII", (U)

Dated 10 August 1962
Revision A Dated 13 September 1963
Revision B Dated 29 January 1964

GE 64-H-200 Secret

"EVALUATION REPORT OF MOD III RADIO GUIDANCE AND INSTRUMENTATION SYSTEM WITH LAUNCH VEHICLE 250D, RANGER VII", (U)

Dated 28 August 1964

GE ET-64-67072 Secret

"PRELIMINARY FLIGHT TEST REPORT MOD III GUIDANCE SYSTEM WITH LAUNCH VEHICLE 250D RANGER SPACE PROJECT RA-B", (U)

Dated 28 July 1964

GODDARD Memo. Confidential

"LAUNCH DATE AND TIME SCHEDULE", (U)
(2)

Dated 22 June 1964
Dated 4 May 1965

GODDARD GLOR-105 Secret

"PROJECT AGENA RANGER VII - FLASH FLIGHT REPORT T+8 HOURS", (U)

Dated 28 July 1964

LMSC A605114 Confidential

"FLIGHT EVALUATION AND PERFORMANCE ANALYSIS
REPORT FOR RANGER VII MISSION", (U)

Dated 10 September 1964

LMSC A659805 (VOL. III, IV AND V) Confidential

"QUICK-LOOK DATA REPORTS", (U)
Test No. RA-VII - Vehicle No. 10205-6009.

Dated 28 July 1964

LMSC 1342656 Confidential

"SEQUENCE OF EVENTS MODEL 10205 VEHICLE 6007", (U)

Dated 15 June 1962

LMSC B040513 Secret

"NASA/ATLAS/AGENA LAUNCH OPERATIONS WORKING
GROUP, RANGER VII LAUNCH REPORT", (U)

Dated 14 August 1964

LMSC A057758-C Confidential

"SYSTEM TEST OBJECTIVES FOR RANGER PROJECT
FLIGHT RA-VI THROUGH RA-IX", (U)

Dated 5 September 1963

STL 8679-6054-TC-000 Confidential

"RANGER VII THIRTY-DAY POST-FLIGHT REPORT", (U)

Dated 25 August 1964

<u>SUBJECT MATTER</u> Confidential

LAUNCH PERIODS FOR RA-VII
SCHEDULE SLIPS FOR RA-VII
PAYLOAD CAPABILITIES FOR BLOCK III RANGER RA-VII

AFMTC Operations Requirement No. 1801 Confidential

"NASA-RANGER LAUNCH BLOCK III - RA-VI
THROUGH RA-IX", (U)

Dated 15 June 1964

GDC AE-62-0520-196 Confidential

"ATLAS SPACE BOOSTER FLIGHT TEST PLAN FOR
BOOSTER NO. 196D", (U)

Dated 1 November 1962

GE 65-C-200 Secret

"EVALUATION REPORT OF MOD III RADIO GUIDANCE AND
INSTRUMENTATION SYSTEM WITH LAUNCH VEHICLE 196D,
RANGER VIII", (U)

Dated 22 March 1965

LMSC 665740 Confidential

"VEHICLE 6006 - FINAL CALIBRATION REPORT", (U)

Dated 12 January 1965

LMSC 1342657 Confidential

"SEQUENCE OF EVENTS MODEL 10205- VEHICLE 6008", (U)

Dated 20 September 1962

LMSC B040697 Secret

"NASA/ATLAS/AGENA LAUNCH OPERATIONS WORKING
GROUP, RANGER VIII LAUNCH REPORT", (U)

Dated 4 March 1965

LMSC A057758-C Confidential

"SYSTEM TEST OBJECTIVES FOR RANGER PROJECT FLIGHTS
RA-VI THROUGH RA-IX", (U)

Dated 5 September 1963

STL 8679-6069-TC-000 Confidential

"RANGER VIII THIRTY-DAY POST-FLIGHT REPORT", (U)

Dated 17 March 1965

SUBJECT MATTER

LAUNCH PERIODS FOR RA-VIII
SCHEDULE SLIPS FOR RA-VIII
PAYLOAD CAPABILITIES FOR BLOCK III RANGER RA-VIII

AFMTC Operations Requirements No. 1801 Confidential

"NASA-RANGER LAUNCH BLOCK III - RA-VI THROUGH RA-IX", (U)

Dated 15 June 1964

GDC AE-62-0520-204 Confidential

"LV-3A 204D FLIGHT TEST PLAN AND INSTRUMENTATION SUMMARY FOR RANGER PROGRAM AT AMR", (U)

Dated 26 December 1963

GE 65-D-200 Secret

"EVALUATION REPORT OF MOD III RADIO GUIDANCE AND INSTRUMENTATION SYSTEM WITH LAUNCH VEHICLE 204D, RANGER IX", (U)

Dated 21 April 1965

LMSC 665588 Confidential

"VEHICLE 6007 - CALIBRATION REPORT", (U)

Dated 18 January 1965

LMSC B040724 Secret

"NASA/ATLAS/AGENA LAUNCH OPERATIONS WORKING GROUP - RANGER IX LAUNCH REPORT", (U)

Dated 8 April 1965

LMSC A057758-C Confidential

"SYSTEM TEST OBJECTIVES FOR RANGER PROJECT FLIGHTS RA-VI THROUGH RA-IX", (U)

Dated 5 September 1963

STL 8679-6054-TC-000 Confidential

"RANGER IX THIRTY-DAY POST-FLIGHT REPORT", (U)

Dated 16 April 1965

SUBJECT MATTER

LAUNCH PERIODS FOR RA-IX

JPL Secret

"AGENA STUDY REPORT", (U)

Dated 1 February 1960

IMSC 1313556 Confidential

"STRUCTURE ASSEMBLY - VEHICLE", (U)

Dated 2 May 1960

IMSC 1313544 Confidential

"BASIC DIMENSIONS 10205", (U)

Dated 9 May 1960

IMSC 1313546 Confidential

"SPACE ALLOCATION NASA - VEHICLE 10205 - 6001 AND UP", (U)

Dated 9 May 1960

IMSC 1313543 Confidential

"BASIC CONFIGURATION MODEL 10205", (U)

Dated 24 May 1960

IMSC 361195 Confidential

"MAS PROPERTIES VS TIME ATLAS/AGENA/RANGER", (U)
Also includes IMSC 361196, 361197 and 361199.

Dated 3 June 1960

IMSC 446553 Confidential

"SPECIFICATION FOR THE AGENA B/RANGER VEHICLE (NASA PROGRAM)", (U)

Dated 13 June 1960

JPL Confidential

"MINUTES OF SIXTH MEETING AGENA-B COORDINATION BOARD", (U)

Dated 30 November 1960

JPL Confidential

"MINUTES OF SEVENTH MEETING AGENA-B COORDINATION BOARD", (U)

Dated 30 November 1960

JPL EPD NO. 16 Confidential

"LUNAR MISSIONS - AMR PRELIMINARY NASA-AGENA COUNTDOWN SEQUENCE", (U)

Dated 12 December 1960

IMSC 1319102-B Confidential

"SYSTEM TEST SPECIFICATION NASA MODEL 10205 SERIALS 6001 - 6005", (U)

Dated 20 December 1960

JPL — Confidential

"MINUTES OF EIGHT MEETING AGENA-B COORDINATION BOARD", (U)

Dated 18 January 1961

LMSC 370804 — Confidential

"NASA LUNAR MISSIONS - AMR (SPACECRAFT-AGENA B ATLAS)", (U)
Preliminary Countdown Manual.

Dated 26 January 1961

JPL LS NO. 309 (Supplement) — Confidential

TO: Dave Margetts FROM: Neville Sue Rapp
SUB: "CHARGE OR POTENTIAL ON SATELLITES AND AIRPLANES CONFIDENTIAL SUPPLEMENT", (U)

Dated 30 January 1961

LMSC 1317953 — Confidential

"RADIO FREQUENCY COMPATIBILITY TEST", (U)

Dated 22 February 1961

LMSC 393567 — Confidential

"SUMMARY OF VIBRATION DATA COMPUTED FOR RANGER", (U)

Dated 17 March 1961

LMSC 447868 — Confidential

"SUBSYSTEM A ENGINEERING ANALYSIS REPORT AGENA B - NASA MISSIONS", (U)

Dated 1 April 1961

GDC AE-61-0388 — Confidential

"ATLAS/AGENA B MISSILE STRUCTURAL CAPABILITIES FOR RANGER PROGRAM", (U)

Dated 13 April 1961

LMSC 447593- (Vol. III) — Confidential

"NASA AMR (PAD 12) GROUND SUPPORT EQUIPMENT ENGINEERING ANALYSIS REPORT (LAUNCH CONTROL SYSTEMS)", (U)

Dated 30 April 1961

GDC AE-61-0458 — Confidential

"CAPTIVE AND FLIGHT LONGITUDINAL AND BENDING LOADS FOR THE ATLAS/AGENA B/RANGER CONFIGURATION", (U)

Dated 15 May 1961

JPL Ltr. — Confidential

TO: H. M. Schurmeier FROM: H. J. Margraf
SUB: "RANGER FOLLOW-ON PROGRAM", (U)

Dated 28 June 1961

LMSC 448384 — Confidential

"NASA AGENA B VEHICLE NO. 6001 PREFLIGHT RELIABILITY ESTIMATE", (U)

Dated 3 July 1961

LMSC 447593-A (Vol. I) — Confidential

"NASA AEROSPACE GROUND EQUIPMENT ENGINEERING ANALYSIS REPORT (GROUND HANDLING AND SERVICE EQUIPMENT)", (U)

Dated 15 September 1961

LMSC A087515 — Confidential

"UNITS OF VARIANCE - SUPPLEMENTAL TO THE WEIGHT AND PERFORMANCE STATUS, NASA RANGER MISSIONS", (U)

Dated 1 November 1961

LMSC 447593-A (Vol. III) — Confidential

"AEROSPACE GROUND EQUIPMENT ENGINEERING ANALYSIS REPORT (LAUNCH CONTROL SYSTEMS)", (U)

Dated 3 November 1961

JPL Ltr. Confidential

TO: J. D. Seaberg (MSFC) FROM: W. E. Giberson/R. J. Parks SUB: "REVISED EXHIBIT "B" LETTER CONTRACT AF-04(647)-924", (U)

Dated 9 November 1961

LMSC 447593-A (Vol. II Rev. A) Unclassified

"NASA AEROSPACE GROUND EQUIPMENT ENGINEERING ANALYSIS REPORT (CHECKOUT EQUIPMENT)", (U)

Dated 24 November 1961

JPL SPEC. NO. 30331D Confidential

"DETAIL SPECIFICATION RANGER SPACECRAFT VEHICLE SYSTEM INTEGRATION REQUIREMENTS AND RESTRAINTS", (U)

Dated 21 December 1961

JPL Confidential

"INTERIM STATUS REPORT OF THE USAF/NASA WORKING GROUP ON LAUNCH VEHICLE STRUCTURES", (U)

Dated 22 December 1961

JPL Confidential

"MINUTES OF MEETING OF NASA/USAF/ AEROSPACE WORKING GROUP ON LAUNCH VEHICLES STRUCTURES", (U)

Dated 1961

JPL EPD NO. 62 Confidential

"A STUDY OF SEVERAL APOLLO-SUPPORT ASPECTS OF THE UNMANNED LUNAR PROGRAM", (U)

Dated 23 April 1962

GE 131-1031-541-8 Secret

"MOD III RADIO GUIDANCE AND INSTRUMENTATION SYSTEM", (U)

Dated April 1962

LMSC A093690 Confidential

"WEIGHT AND PERFORMANCE STATUS - NASA MISSIONS", (U)

Dated 1 May 1962

JPL Secret

"PERFORMANCE STUDY OF MEDIUM CLASS LAUNCH VEHICLES", (U)

Dated 9 May 1962

GDC AE-62-0520 Confidential

"ATLAS SPACE BOOSTER FLIGHT TEST PLAN FOR ATLAS-AGENA B-RANGER-PROGRAM AT AMR", (U)

Dated 15 June 1962

JPL Ltr. Confidential

TO: H. M. Schurmeier FROM: H. J. Margraf SUB: "LUNAR AND PLANETARY LAUNCH VEHICLE NEEDS", (U)

Dated 27 June 1962

LMSC 448139-A Confidential

"SUBSYSTEM C ENGINEERING ANALYSIS REPORT AGENA B - NASA", (U)

Dated 1 July 1962

LMSC 447590-B Confidential

"RANGER/MARINER FLIGHT TERMINATION SYSTEM", (U)

Dated 9 July 1962

LMSC A048053 Confidential

"RELIABILITY ESTIMATE AND ANALYSIS FOR NASA AGENA B VEHICLES", (U)
Vehicles 6901 & 6902

Dated 15 July 1962

GDC AE-61-0885 (Section II) Secret

"SUMMARY OF FLIGHT TEST RESULTS", (U)

Dated 31 August 1962

STL 9321.4-392 Confidential

"OBSERVED RANGER/MARINER VERINER LENGTH VARIATIONS", (U)

Dated 5 November 1962

LMSC 447725 Confidential

"NASA AGENA PROPULSION SYSTEM ENGINEERING ANALYSIS REPORT (REPORT CHANGE RECORD)", (U)

Dated 3 December 1962

GDC AE-61-0360 (Rev. A & B) Confidential

"REVISION A TO FINAL REPORT FOR TAD 019 PART B THREE SIGMA ERROR STUDY", (U)

Dated 7 December 1962

LMSC 447892-C Confidential

"NASA ENGINEERING ANALYSIS REPORT SUBSYSTEM D (GUIDANCE AND CONTROL)", (U)

Dated 15 December 1962

LMSC 448525 Confidential

"ATLAS/AGENA B SYSTEM PERFORMANCE DISPERSIONS RELIABILITY ESTIMATE", (U)

Dated December 1962

IMSC A060673-A Confidential

"FLIGHT TERMINATION SYSTEM FOR RANGER VEHICLES 6006 THROUGH 6009", (U)

Dated 3 January 1963

IMSC A372061 Confidential

"BOOSTER STEERING FOR NASA ATLAS/AGENA AMR LAUNCHES", (U)

Dated 3 January 1963

GDC A-63-0019 Confidential

"ATLAS/RANGER BOOSTER STEERING CONSTRAINT STUDY", (U)

Dated 15 January 1963

IMSC A082408-A Confidential

"AGENA PERFORMANCE IMPROVEMENT STUDY FINAL REPORT", (U)

Dated 20 February 1963

IMSC A376108 Confidential

"QUARTERLY RELIABILITY ESTIMATE AND ANALYSIS FOR NASA VEHICLES (VEHICLES 6006, 6007, 6008 and 6009)", (U) BLOCK III RANGER

Dated 3 June 1963

STL 9321.4-499 (Rev. E) Confidential

"RANGER/MARINER/EGO/OAO EQUATIONS SPEC.", (U)

Dated 7 June 1963

STL 9321.3-954 (TWX) Confidential

"NEW ACTION ITEMS RESULTED FROM THE 11 JUNE 1963 AMR GUIDANCE CONTRACTORS' TECHNICAL REVIEW MEETING", (U)

Dated 14 June 1963

STL 9321.4-569 Confidential

"RANGER/MARINER/EGO/OAO GUIDANCE EQUATIONS (DOCUMENT 3/E-7)", (U)

Dated 22 July 1963

JPL SPEC. NO. RCO-50012-DSN Unclassified

"DESIGN SPECIFICATION RANGER BLOCK III TRAJECTORY LUNAR IMPACT CRITERIA", (U)

Dated 25 July 1963

GDC A-63-512-0-001 Confidential

"CALCULATION OF FULL-SCALE GROUND WIND LOADS FROM WIND TUNNEL DATA", (U)

Dated 11 September 1963

STL 9321.3-1050 Confidential

"RANGER/MARINER/EGO/OAO PROGRAMMED GUIDANCE EQUATIONS AND CONSTAINTS (DOCUMENT 7/E-7)", (U)

Dated 23 September 1963

STL 9321.4-618 (Rev. A) Confidential

"GUIDANCE SYSTEM TEST RESULTS (DOCUMENT 9/E-7)", (U)

Dated 30 September 1963

STL 9321.4-633 Confidential

"DETERMINATION OF RADAR DEPENDENT MANUAL CONSTANTS FOR RANGER/MARINER/EGO/OAO EQUATIONS", (U)

Dated 16 October 1963

STL 9321.4-638 Confidential

"RANGER/MARINER GUIDANCE EQUATION ACCURACY VERSUS RADAR ELEVATION AT VECO", (U)

Dated 28 October 1963

LMSC A377427 (Addendum A377427-1) Confidential

"SUBSYSTEM A ENGINEERING ANALYSIS REPORT AGENA B - NASA MISSIONS", (U) BLOCK III RANGER

Dated 6 November 1963

NASA Hdq. Confidential

"RANGER PROJECT STATUS REVIEW AGENDA", (U)

Dated 7 November 1963

NASA Hdq. Confidential

"RANGER PROJECT REVIEW", (U)

Dated 7 November 1963

GE 63-K-210 Confidential

"PROGRAM REQUIREMENTS OF DOCUMENT RANGER/ MARINER PROGRAM LAUNCH VEHICLE GUIDANCE SYSTEM", (U)

Dated 15 November 1963

LMSC 271739 Confidential

"ATLAS/AGENA WORKING GROUP LAUNCH TEST DIRECTIVE RANGER BLOCK III", (U)

Dated 22 November 1963

LMSC 447725-A Confidential

"SUBSYSTEM B ENGINEERING ANALYSIS REPORT AGENA B - NASA MISSIONS", (U)

Dated 25 November 1963

AFMTC Operations Directive No. 1801 Confidential

"NASA-RANGER LAUNCH BLOCK III", (U)

Dated 27 November 1963

LMSC A633009 Confidential

"STANDARD AGENA PERFORMANCE IMPROVEMENT PROGRAM PAYLOAD GAIN", (U)

Dated 20 January 1964

LMSC A602652 Confidential

"ATLAS/AGENA B ERROR SOURCE DEFINITIONS FOR RANGER UNITS OF VARIANCE ANALYSIS", (U)

Dated 6 February 1964

JPL IOM Confidential

"JPL LUNAR AND PLANETARY LAUNCH SCHEDULE", (U)

Dated 13 March 1964

JPL LS NO. 541 (Supplement No. III) Confidential

TO: Don Stelma FROM: Carol K. Sterkin SUB: "CHARGE AND DISCHARGE OF STATIC ELECTRICITY ON AIR AND SPACE VEHICLES IN FLIGHT, AND RELATED PHENOMENA", (U)

Dated 26 May 1964

LMSC A604415 Confidential

"ATLAS/AGENA PERFORMANCE IMPROVEMENT STUDY (RANGER/MARINER SOFTWARE CHANGES)", (U)

Dated 15 July 1964

STL 9321.4-777 Unclassified

"GUIDANCE EQUATIONS FOR EGO-A", (U), by P. D. Joseph

Dated 22 July 1964

STL 9321.4-778 Confidential

"EGO GUIDANCE SYSTEM RESULTS", (U)

Dated 4 August 1964

RANGER DOCUMENTS FOR 1964 (PAGE 2)

GDC CHA-64-008 — Confidential

"ATLAS SLV-3/LTV VELOCITY PACKAGE FOR BOOSTING THE EXTENDED PIONEER PAYLOAD", (U) JUNO II (PRE-RANGER).

Dated 7 August 1964

AFMTC Program Requirement No. 1800 — Unclassified / Confidential

"RANGER", (U)

(Unclassified Part) Dated 6 April 1964
(Classified Part) Dated 20 October 1964

NGER DOCUMENTS - CURRENTLY UP-DATED

NASA - Hdq. — Confidential

"OFFICIAL NASA FLIGHT SCHEDULES", (U)

NOTE: WE ARE ON DISTRIBUTION TO RECEIVE OFFICIAL NASA FLIGHT SCHEDULES - EVERY MONTH.

MISCELLANEOUS - BY SUBJECT MATTER

RANGER - IMPACT PROBABILITY STUDY FOR AFRICA UTILIZING 78° TO 90° AZIMUTH

LAUNCH PERIODS FOR A, B AND D

PROJECT STATUS REVIEW AGENDA
PROGRAM RANGE SAFETY ANALYSIS IMPACT PROBABILITY

TENTATIVE RANGER REPROGRAMMING

PRINTS & PHOTOGRAPHS

RANGER DOCUMENTS - CURRENTLY UP-DATED

LMSC 447186-23 through 447186-49 — Confidential

"MEDIUM SPACE VEHICLES PROGRAMS MONTHLY PROGRESS REPORTS", (U)

NOTE: WE ARE ON DISTRIBUTION TO RECEIVE (MEDIUM SPACE VEHICLES PROGRAMS MONTHLY PROGRESS REPORTS) - EVERY MONTH.

LMSC A605205 through A605205-2 — Confidential

"SATELLITES AND PROBES PROGRAM PROGRESS REPORTS", (U)

NOTE: WE ARE ON DISTRIBUTION TO RECEIVE SATELLITES AND PROBES PROGRAM PROGRESS REPORTS - EVERY MONTH.

LMSC A048135 — Confidential

"PRODUCT ASSURANCE REPORTS, "PRE-FLIGHT FAILURE/DISCREPANCY ANALYSIS NASA PROGRAM", (U)

NOTE: MONTHLY REPORTS FOR 1963 AND JANUARY TO FEBRUARY 1964.

LMSC A088866-9 through 27 — Confidential

"AGENA FLIGHT HISTORY SUMMARY AND COUNTDOWN TERMINATION SUMMARY", (U)

NOTE: WE ARE ON DISTRIBUTION TO RECEIVE AGENA FLIGHT HISTORY SUMMARY AND COUNTDOWN TERMINATION SUMMARY - EVERY MONTH.

NASA - Lewis Research Center — Confidential

"NASA/LEWIS AGENA VEHICLE REAFFIRMATION SCHEDULES", (U)

NOTE: WE ARE ON DISTRIBUTION TO RECEIVE AGENA VEHICLE REAFFIRMATION SCHEDULES - EVERY MONTH.

NASA - Hdq. — Confidential

"AGENA LAUNCH VEHICLE PROGRAM", (U) (PMP)

NOTE: WE ARE ON DISTRIBUTION TO RECEIVE (PMP) - EVERY MONTH.

APPENDIX I

RANGER UNCLASSIFIED DOCUMENTS

Appendix I is a list of unclassified documents used at JPL relating to launch vehicle integration in the Ranger Program. The location of each document is indicated to facilitate ease of access. These locations are specifically:

"Microfilmed" indicates that the document has been microfilmed and is available from the vellum file in Section 614.

"Reorder No." indicates that a copy of the document may be obtained by Reorder number from Section 614.

"In File" indicates that the document is available in Section 291 files.

RANGER - GENERAL LIST (LMSC)

LMSC	PB-6b	Microfilmed
	Cleaning of Rocket Engines and Propellant Systems Dated 28 February 1961	
LMSC	PB-14C	Microfilmed
	Contamination Control of Hydraulic System and Components, SS Vehicle and Check-out Equipment. Dated 28 February 1961	
LMSC	PB-29A	Microfilmed
	Limited-Calendar-Life Materials and Parts, Control of. Dated 27 June 1962	
LMSC	PB-48	Microfilmed
	Oxide Finish Blackening of Stainless Steel, Process for. Dated 5 May 1961	
LMSC	LAC-0401A	In File
	Installation of Electrical and Electronic Wiring (Specification) Dated 10 February 1961	
LMSC	LAC-0409	In File Reorder No. 60-544
	Connectors, Wiring and Safetying of (Specification). Dated 1 December 1958	
LMSC	LAC-0410	In File
	Coaxial Cables and Connectors, Assembly of (Specification). Dated 15 November 1958	
LMSC	LAC-0410A	In File
	Termination of Shielded Cables, Amendment #1. Dated 10 December 1960	
LMSC	LAC-0419	In File Reorder No. 60-543
	Embedding and Coating of Electrical Components Dated 10 July 1960	

LMSC	LAC-0430 Harness and Cable Assemblies. Dated 1 August 1959	In File Reorder No. 60-543
LMSC	LAC-0431A Identification of Wiring and Connecting Devices. Dated 10 October 1960	In File
LMSC	LAC-0438 Electrical and Electrical Test Methods Dated 15 August 1958	In File
LMSC	LAC-0583 Safetying Practices. Dated 15 July 1959	In File
LMSC	LAC-1425 Soldering (General) (Specification). Dated 15 November 1958	Library
LMSC	LAC-1481 Controlled Environment Area (Specification). Dated 10 August 1960	Library
LMSC	15227 Forward Section and Nose Cone Static Tests. Dated 25 June 1961	Microfilmed
LMSC	15240 Data Systems Accuracy Report. Dated 11 July 1961	Reorder No. 61-231
LMSC	LR-15291 Nose Cone Elevated Temperature Test 10205. Dated 12 July 1961	Microfilmed
LMSC	15689 Spacecraft Separation Test. Dated 9 May 1962	Library

LMSC A-049641 Reorder No. 62-172

Weight and Performance Status
NASA Missions.

Dated 1 June 1962

LMSC A-049934 Reorder No. 62-544

Structural Design Criteria Qualification
and Acceptance Test Requirements for
Major Spacecraft Assemblies Format.

Dated 31 May 1962

LMSC A-049935 Reorder No. 63-68

General Structural Design Criteria and
Requirements for Spacecraft Systems Format.

Dated 1 June 1962

LMSC AD-52704 Reorder No. 62-219

Weight and Performance Status -
NASA Missions.

Dated 1 July 1962

LMSC AD-59052 Reorder No. 62-291

Weight and Performance Status -
NASA Missions.

Dated 1 September 1962

LMSC C-60102A In File

Spacecraft Ejection System, Alignment
Check and Recording Procedure 10205 (Specification).

Dated 8 November 1962

LMSC A060673C In File
Reorder No. 64-268

Flight Termination Separation RA-6006 -
6009 and EOGO and Mariner C.

Dated 19 June 1964

LMSC A073505 Reorder No. 62-555

Structural Criteria for Winds Aloft.

Dated 14 February 1962

LMSC A-076037 Reorder No. 62-171

NASA/Agena B Follow-on Program Letter,
Contract Designated Supplemental Agreement

Dated 15 March 1962

LMSC A-08621 Reorder No. 61-516

Structural Design Criteria Qualification and Acceptance Test Requirements for Major Spacecraft Assemblies.

Dated 24 November 1961

LMSC 93298-62-93 Reorder No. 62-10

NASA/Agena B Program Ranger and Mariner R Missions Guidance Type Launch Window Requirements

Dated 1962

LMSC ETR-133098 In File

Ranger Block III Master J-FACT Countdown.

Dated 15 January 1965

LMSC 271204 Microfilmed

NASA/Agena-B Ranger Program

Dated (No date)

LMSC 271914 In File

Pad Safety Report for S-01 Vehicle Model 10205 and Ranger (Block III) S/C Complex 12, AFMTC.

Dated 17 December 1963

LMSC A306200 In File

Weight and Performance Status - NASA Missions.

Dated 1 October 1962

LMSC 306612A Reorder No. 64-466

C&C Subsystem Engineering Analysis Report, Agena Vehicles 6006 through 6009 (Ranger Program).

Dated 1 September 1964

LMSC A306644 Reorder No. 62-379

Weight and Performance Status - NASA Missions.

Dated 1 November 1962

LMSC A-340161 Microfilmed

Weight and Performance Status - NASA Missions.

Dated 1 December 1962

LMSC	A-340634	In File Reorder No. 63-3
	Weight and Performance Status - NASA Missions. Dated 1 January 1963	
LMSC	367949/62-44	Microfilmed
	Electrical Interface Requirements NASA Project Model 10205-6001 Dated 2 December 1960	
LMSC	370804-2	Microfilmed
	Ranger Lockheed/General Dynamics/JPL Countdown Dated 22 July 1961	
LMSC	372165	In File Reorder No. 63-21
	Weight and Performance Status - NASA Missions. Dated 1 January 1963	
LMSC	372315	In File Reorder No. 63-30
	NASA-Agena Shroud and Spacecraft Adapter Configurations. Dated 2 October 1963	
LMSC	374041	In File Reorder No. 63-66
	Weight and Performance Status - NASA Missions. Dated 1 March 1963	
LMSC	374064	In File Reorder No. 63-61
	Preliminary Weight and Performance Status. Dated 18 March 1963	
LMSC	A-374183	In File Reorder No. 63-85
	Weight and Performance Status - NASA Missions. Dated 1 April 1963	

LMSC	A-374487	In File Reorder No. 63-143
	Weight and Performance, NASA Missions. Dated 1 May 1963	
LMSC	A-376143	In File Reorder No. 63-201
	Weight and Performance Status - NASA Missions. Dated 14 June 1963	
LMSC	A-376330	In File Reorder No. 63-249
	Weight and Performance Status - NASA Missions. Dated 1 July 1963	
LMSC	A-376330-1	In File Reorder No. 63-267
	Weight and Performance Status - NASA Missions. Dated 1 August 1963	
LMSC	A-376330-2	In File Reorder No. 63-317
	Weight and Performance Status - NASA Missions. Dated 1 September 1963	
LMSC	A-376330-3	In File Reorder No. 63-345
	Weight and Performance Status - NASA Missions. Dated 1 October 1963	
LMSC	A-376330-4	In File Reorder No. 63-414
	Weight and Performance Status - NASA Missions. Dated 1 November 1963	
LMSC	A-376330-5	In File Reorder No. 63-498
	Weight and Performance Status - NASA Missions. Dated 1 December 1963	

LMSC A-376330-6 In File
Reorder No. 64-8

Weight and Performance Status - NASA Missions.

Dated 1 January 1964

LMSC A-376330-7 In File
Reorder No. 64-34

Weight and Performance Status - NASA Missions.

Dated 1 February 1964

LMSC A-376330-8 In File
Reorder No. 64-92

Weight and Performance Status - NASA Missions.

Dated 1 March 1964

LMSC A-376835 In File
Reorder No. 63-565

Basic Reliability Program Plan for LeR[C] Agena Programs

Dated 12 August 1964

LMSC A-377154 In File
Reorder No. 63-738

Spacecraft Cooling Techniques

Dated 15 October 1963

LMSC A-377602 In File
Reorder No. 63-675

Block III Ranger Agena B Final Design Review.

Dated 17 October 1963

LMSC SP38XX-64-1 In File
Reorder No. 64-130

Weight and Performance Status - NASA Missions.

Dated 1 April 1964

LMSC SP38XX-64-1-1 In File
Reorder No. 64-182

Weight and Performance Status - NASA Missions.

Dated 1 May 1964

LMSC SP38XX-64-1-2 In File
Reorder No. 64-235

Weight and Performance Status- NASA Missions.

Dated 1 June 1964

LMSC SP38XX-64-1-3 In File
Reorder No. 64-285

Weight and Performance Status Report
NASA Missions.

Dated 1 July 1964

LMSC SP38XX-64-1-4 In File
Reorder No. 64-327

Weight and Performance Status Report
NASA Missions.

Dated 1 August 1964

LMSC SP3800-64-3 In File
Reorder No. 64-202

Horizon Sensor - Cloud Cover Criteria
for NASA Agena Launches

Dated 6 May 1964

LMSC A-384258 In File

Summary Report, Structural Dynamics and
Load Data Ranger 6001 through 6005.

Dated 28 December 1963

LMSC A-393631 In File
Reorder No. 63-800

Equations of Motion in Six Degrees of
Freedom of a Two-body System Separated
by Springs.

Dated 1 November 1963

LMSC 445967 Reorder No. 61-178

Nose Cone Pin-puller Pull Capability
LMSD No. 1301 682-501 or 503.

Dated (No date)

LMSC 446430 Reorder No. 61-127

NASA/Agena B Reliability Program
Document

Dated 27 April 1961

LMSC 446554 Library

NASA/Agena B Launch Complex Performance
Specification (AMR)

LMSC 446550 Library

Advanced Development Program

LMSC	446556	Reorder No. 61-206
	Ground Handling and Service Equipment Test Phase Performance Specification for NASA Program, AMR Dated 17 March 1961	
LMSC	447820	Library
	Specifications for NASA/Agena Flight Termination System Dated 11 January 1961	
LMSC	447969-B	In File
	Electro Magnetic Interference Control Requirements and Electrical Interface for Agena Dated 1 August 1962	
LMSC	448139-B	Library
	Subsystem C for LeRC Agena Programs Engineering Analysis Report Dated 11 November 1963	
LMSC	448321	Library
	Ranger/Agena B Compatibility Test Dated 9 June 1961	
LMSC	448567	Microfilmed
	Personnel Subsystem Progress Report NASA/Agena B Program	
LMSC	A602037-A	In File Reorder No. 64-568
	MSVP Bibliography - Satellites and Probes Programs Dated 30 June 1964	
LMSC	A602502-B	In File
	Launch and Hold Limitations for Agena B Vehicles Dated 10 March 1964	
LMSC	A604167	In File Reorder No. 64-259
	First Quarterly Reliability Program Status Report Dated 11 June 1964	

LMSC A604116-5 In File
Reorder No. 65-48

Weight and Performance Status Report
NASA Missions

Dated 1 February 1965

LMSC A605116-6 In File
Reorder No. 65-154

Weight and Performance Status Report
NASA Agena Satellite and Probe Missions

Dated 1 March 1965

LMSC A605205-3 In File
Reorder No. 64-673

Satellites and Probes Program Progress
Report

Dated 20 December 1964

LMSC A605205-6 In File
Reorder No. 65-157

Satellites and Probes Program Progress
Report

Dated February 1965

LMSC A605205-4 In File
Reorder No. 65-14

Satellites and Probes Program Progress
Report

Dated 20 January 1964

LMSC A605205-5 In File
Reorder No. 65-59

Satellites and Probes Program Progress
Report

Dated January 1965

LMSC A610655 Library

Structural Qualification Test of the Ranger
Block III Spacecraft Support, LMSC Part
Number 1360224, and Interface Assemblies
RA-5806

LMSC 650410 In File
Reorder No. 59-661

Insertion Voltage Techniques in
Calibrating Dynamic Data

Dated 28 August 1959

LMSC	A651443	In File Reorder No. 64-580
	Second Quarterly Product Assurance Status Report Dated 9 November 1964	
LMSC	A653529	In File Reorder No. 64-703
	Ranger Agena Vehicle Instrumentation Handbook Dated 11 December 1964	
LMSC	A729524	In File Reorder No. 65-169
	Torsional Analysis of the EOGO Vehicle Dated 20 January 1965	
LMSC	A729973	In File Reorder No. 65-27
	Reliability Estimate and Analysis Report Dated 25 January 1965	
LMSC	919735	Reorder No. 61-306
	Launch Control System Electric Drawings FTV 6001-FLT, August 22, 1961 Dated 22 August 1961	
LMSC	921662-B	Reorder No. 62-200
	NASA AMR Aerospace Ground Equipment Engineering Analysis Report, Revision B - Vol. III - Launch Control Systems Dated 30 March 1962	
LMSC	922052-B	Reorder No. 62-169
	Volume I - Revision B Ground Handling and Service Equipment Report Dated 20 April 1962	
LMSC	922056-B	Reorder No. 62-302
	NASA Aerospace Ground Equipment Engineering Analysis Report. Vol. II Revision D - Checkout Equipment Dated 30 May 1962	
LMSC	1067061-G	In File
	Squib,Pressure, Pyro, Electrically Initiated (Specification) Dated 16 August 1961	

LMSC 1067280 In File

Connector, Electrical, Umbilical

Dated 3 October 1960

LMSC 1068634 In File
Reorder No. 60-548

Design Control, Cable, Multiconductor, Class B

Dated 18 August 1960

LMSC 1068844 In File

C-Band Beacon Antenna

Dated 12 May 1960

LMSC 1068956-A In File
Reorder No. 60-467

Design Specification for Spring Mechanism NASA Spacecraft

Dated 5 August 1960

LMSC 1069017-E In File

C-Band Radar Transponder

Dated 24 June 1960

LMSC 1069144-A In File

Design Specification for Spring Mechanism, Nose Cone Separation

Dated 7 February 1961

LMSC 1069150 In File
Reorder No. 60-538

RF Data Link System NASA

Dated 20 September 1960

LMSC 1072028 In File

Acceptance Test, Propellant Pressurization System

Dated 4 June 1958

LMSC 1072210 In File

Acceptance Test, Pin-puller Squib Actuated

16 January 1959

LMSC 1072318 In File

Statham Accelerometers - Strain Gage Type

Dated 4 May 1959

LMSC1072390 In File

Pin-puller Squib Actuated
Dated 20 May 1959

LMSC 1072407 In File

Sequence Timer Subsystem D
Dated 4 October 1960

LMSC 1072452 In File

SS/G Data Link, Final System Checkout
Vehicle Airborne Equipment, 32 Channel
Dated 25 June 1959

LMSC 1072472 In File

Propellant Tank Acceptance Test
Dated 13 June 1960

LMSC 1320031-A Microfilmed

Vehicle Test Plan

LMSC 1342057 In File

Vehicle Test Plan 10205-6006 through 6009
Dated 21 May 1962

LMSC 1342542 In File

Vehicle Functional Schematics
Dated 17 December 1963

LMSC 1410032 In File

Amplifier Assembly, Pneumatic Channel,
Flight Control
Dated 3 November 1960

LMSC 1410039 In File

Omni-Directional Antenna Coupler
Dated 17 April 1961

LMSC 1410040 In File

Parabolic Antenna Coupler, 10205-6001 and Up
Dated 21 December 1960

LMSC 1410048 In File

Leak Test Model 10205 Spacecraft
Section
Dated 23 September 1960

LMSC 1410071 In File

Design Specification, Cable Assembly,
Electrical Coax Quick Disconnect

Dated 25 November 1960

LMSC 1410082 In File

Parasitic Antenna, 10205

Dated 4 November 1960

LMSC 1410123-B In File

C-Band Beacon Antenna System

Dated 28 December 1960

LMSC 1410124 In File

VHF Telemetering Antenna System,
10205-6001 and Up

Dated 28 December 1960

LMSC 1410125 In File

Low Power L-Band Antenna System

Dated 21 November 1960

LMSC 1410126 In File

High Power L-Band Antenna System
10205-6001 and Up

Dated 28 December 1960

LMSC 1410296-B In File

Design Specification for Installation of
S/C to Support Structure

Dated 4 January 1961

LMSC 1410624 In File

Alignment Spring Mechanical Nose Cone
Separation Model 10205

Dated 23 February 1961

LMSC 1410651 In File

Equipment Installation and Dimensional Checkout,
Antenna Coupler and Thermal Shield

Dated 13 February 1961

LMSC 1412336 In File

Equipment Installation and Dimensional Checkout,
Antenna Coupler and Thermal Shield

Dated 13 February 1961

LMSC	1412645	In File
	Design Specification for Installation of S/C to Support Structure Dated 6 October 1961	
LMSC	1412706-A	In File
	Telemeter, FM/FM, Type III Dated 27 December 1961	
LMSC	1412799-B	In File
	Specification, Telemeter FM/FM Dated 14 August 1962	
LMSC	1414356-A	In File
	C & C Subsystem, 6006-6009 Dated 21 September 1962	
LMSC	1415296-A	In File
	Prematchmate Preparation of Nose Cone and S/C Support Dated 14 November 1962	
LMSC	1415559-C	In File
	Matchmate of Ranger S/C and Nose Cone to JPL Structure RA-VIII and IX Dated 5 November 1963	

RANGER - GENERAL LIST (GD/C)

GDC 7B-1834-1 Library
Reorder No. 61-224

Functional Testing of Separation Cartridges

Dated (No Date)

GDC 55E-1005 Library
Reorder No. 61-228

Load vs Deflection Tests on Small Hemisphere, Special Bulkhead, Model 27

Dated (No Date)

GDC 55-06101 Reorder No. 59-554

Inverter, Static, Missileborne, Specification for

Dated (No Date)

GDC 55-02102 Reorder No. 60-519

Battery, Main Power, Missileborne Equipment

Dated (No Date)

GDC AE60-0493 Library
Reorder No. 62-231

General Trajectory Program for Earth Referenced Space Flights

Dated 23 May 1960

GDC AE61-0032 Library
Reorder No. 61-394

Precision Flight Control System

Dated 20 January 1961

GDC AE61-1143 Library
Reorder No. 62-28

Instrumentation Configuration Special Intermediate Bulkhead Heat Transfer Test on C-3

Dated (No Date)

GDC AE62-0501 Library

Atlas Series "D" Backup Guidance

Dated 24 August 1962

GDC	AOC63-0406	Library
	Bibliography of Research and Development Dated 15 March 1963	
GDC	(No Number)	Microfilmed Reorder No. 60-422
	Effects of Launching Time on Space Navigation Problems Dated 1960	
GDC	950-0-41	Library
	Assessment of Marshall Space Flight Center's Ad Hoc C Committee Recommendation (Preliminary) Dated 22 August 1962	
GDC	(No Number)	Library
	Atlas Space Booster Familiarization Course Dated 1 August 1962	
GDC	AZM-066	Microfilmed Reorder No. 59-558
	Analysis of Crosstalk and Methods for Reducing Crosstalk in Parallel Lines Dated 20 April 1959	
GDC	7-00209B	Microfilmed Reorder No. 60-517
	Environmental Design Conditions and Environmental Test Procedures for 107A-1 Dated 1 March 1958	
GDC	(No Number)	In File
	Atlas Space Launch Vehicle Orientation (Atlas School) Dated 19 August 1963	

RANGER I

LMSC 1319297-B In File

Vehicle Test Plan, 10205-6001

Dated 18 January 1961

LMSC 1313757 In File
Microfilmed

Telemeter System Instrumentation
Series 10205-6001

Dated 28 July 1961

RANGER II

LMSC 132997 Microfilmed

Ranger/Lockheed/General Dynamics/JPL
Countdown Agena B 6002/Atlas 117D
Ranger RA-II

Dated (No Date)

LMSC 1320030-A Microfilmed

Vehicle Test Plan, 10205-6002

Dated (No Date)

RANGER III

LMSC SSN-T62-5 Library

Launch Pad Damage Report for Atlas
121D/Agena-B 10205-6003 Ranger
Spacecraft RA-III Complex, AMR

Dated 1 February 1962

LMSC 1313759 In File
Microfilmed

Telemeter System Instrumentation
Schedule Model 10205 S/N 6003

Dated (No Date)

RANGER IV

LMSC SSQ-592-T62-1 Library

Launch Pad Damage Report for Atlas
133D/Agena-B 10205-6004 Ranger
Spacecraft RA-IV, Complex 12, AMR

Dated 27 April 1962

LMSC 291549 Reorder No. 62-64

Atlas/Agena Working Group Flight
Test Directive Ranger IV

Dated (No Date)

LMSC 271553 Microfilmed

Ranger/Lockheed/General Dynamics/JPL
J-FACT Vol. I of II Agena - B6004
Atlas/133D/Ranger RA-IV

Dated (No Date)

LMSC 1313761 Microfilmed

Telemeter System Instrumentation
Schedule Model 10205-6004

Dated (No Date)

LMSC 1320032 Microfilmed

Vehicle Test Plan, 10205-6004

Dated (No Date)

RANGER V

LMSC 1313760 Microfilmed

Telemeter System Instrumentation
Schedule Model 10205-6005

Dated (No Date)

LMSC 1320033 Microfilmed

Vehicle Test Plan, 10205-6005

Dated (No Date)

RANGER VI

LMSC 1342585 In File

RA-VI Telemeter Systems Instrumentation
Schedule 10205-6008

Dated 28 April 1962

LMSC C60106 In File

RA-VI Alignment Spring Mechanism Nose
Cone Separation, 10205

Dated 14 November 1962

LMSC	C60105A		In File
		RA-VI Mating Procedure Nose Cone Adapter, Specification	
		Dated 17 January 1963	
LMSC	1360726		In File
		Vehicle Test Plan, 10205-6008	
		Dated 19 June 1963	
LMSC	C60104		In File
		RA-VI Mating Procedure Spacecraft to Adapter, Specification	
		Dated 30 October 1963	
LMSC	1342657-E		In File
		RA-VI Sequence of Events	
		Dated 11 November 1963	

RANGER VII

LMSC	1342566-A		In File
		RA-VII Telemeter System Instrumentation Schedule 10205-6009	
		Dated 28 April 1962	
LMSC	AD60673B		In File Reorder No. 63-433
		Flight Termination System, RA 6009 and EOGO	
		Dated 1 November 1963	
LMSC	1342658-E		In File Reorder No. 64-313
		RA-VII Sequence of Events	
		Dated 22 June 1964	
LMSC	ETR 133099A		In File Reorder No. 64-293
		Ranger VII Ranger Block III Master Launch Countdown	
		Dated 1 July 1964	
LMSC	A658527		Library
		Final NASA Vehicle 6009 - Calibration Report	
		Dated (No Date)	

RANGER VIII

LMSC 1342583-B — In File

RA-VIII Telemeter System Instrumentation
Schedule 10205-6006

Dated 13 February 1962

LMSC 1415559-C — In File

Matchmate of Ranger S/C & Nose Cone to
JPL Structure RA-VIII & RA-IX

Dated 5 November 1963

LMSC 1342655-F — In File
Redorder No. 65-7

RA-VIII Sequence of Events

Dated 19 February 1964

LMSC C60601-B — In File

Telemetry System Validation Test
RA-VIII & RA-IX

Dated 17 March 1964

LMSC C60602-C — In File

Vehicle Instrument Checkout & Calibration
RA-VIII & RA-IX

Dated 16 April 1964

LMSC A605574 — In File
Reorder No. 64-706

Match Mate of Vehicle 6006 Nose Cone
and Adapter to RA-VIII

Dated 29 September 1964

LMSC C60601-B — In File

Telemetry System Validation Test -
RA-VIII & RA-IX

Dated 9 December 1964

LMSC C60609 — In File

Acceleration Vibration System Calibration -
RA-VIII & RA-IX

Dated 29 December 1964

LMSC A729964 — In File
Reorder No. 65-16

Ranger 6006 Re-matchmate Test Summary

Dated 11 January 1965

LMSC ETR 133099-B In File
Reorder No. 65-19

RA-VIII Ranger Block III Master Countdown

Dated 15 January 1965

LMSC J-01-65-1 In File

End-to-end Calibration, Ranger VIII

Dated 11 February 1965

LMSC 1342584 In File

RA-IX Telemeter Systems Instrumentation Schedule 10205-6007

Dated 28 April 1962

LMSC 1415559-C In File

Matchmate of Ranger S/C & Nose Cone to JPL Structure RA-VIII & RA-IX

Dated 5 November 1963

LMSC C60601-B In File

Telemetry System Validation Test

Dated 17 March 1964

LMSC C60602-C In File

Vehicle Instrument Checkout & Calibration

Dated 16 April 1964

LMSC C60601-B In File

Telemetry System Validation Test - RA-VIII & RA-IX

Dated 9 December 1964

LMSC 1371019 In File

RA-IX Sequence of Events 10205-6007

Dated 17 December 1964

LMSC C60609 In File

Acceleration Vibration System Calibration RA-VIII & RA-IX

Dated 29 December 1964

APPENDIX J

POST-FLIGHT ANALYSES DOCUMENTATION

Appendix J tabulates the postflight documentation made on the Ranger Block III vehicles. Since most of these reports are classified, they also appear in Appendix H.

ORGANIZATION	TITLE	Spacecraft / Agena / Atlas	RA-6 6008 199D	RA-7 6009 250D	RA-8 6006 196D	RA-9 6007 204D
AFMTC	Operations Requirements		1801	1801	1801	1801
GD-C	Atlas Space Booster Flight Test Plan		AE-62-0520 -199D	AE-62-0520 -250D	AE-62-0520 -196D	AE-62-0520 -204D
GE	Evaluation Report of Mod III Radio Guidance and Instrumentation System		64-D-200	64-H-200	65-C-200	65-D-200
GE	Preliminary Flight Test Report for L/V		64-67054	ET-64-67072	ET-65-56752	ET-65-56755
GLOR	Ranger Flash Flight Report T+8 Hours			1-5	159 (Unclassified)	167 (Unclassified)
LMSC	Flight Evaluation and Performance Report (45-Day Report)		A603322	A605114	A731742	A744185
LMSC	Quick-Look Data Reports (Vol. II, IV & V)		A658747 Vol. I & III	659805		
LMSC	Sequence of Events Block III (Unclassified)		1342658E	P342658E	1342655F	1371019
LMSC	NASA/Atlas/Agena Launch Operation Working Group		B040418	B040513	B040697	B040124
LMSC	System Test Objectives		A057758C	(Same)	(Same)	(Same)
LMSC	Vehicle Calibration Report (Final)		657744	658527	665740	665588
GD-C	Atlas Launch Vehicle Flight Test Evaluation Report		BGJ-64-002	GDC/BKF 64-032	GDC/BKF 65-008	GDC/BKF 65-019
Lear Siegler	Ranger VI Launch Vehicle System Success Analysis		ER-620 & ER-620-1			
LMSC	Minutes of RA-VI Postflight Analysis Meeting		A602894			
STL	Ranger Thirty Day Postflight Report		8679-6046 -TC000	8679-6054 -TC000	8679-6069 -TC000	8679-6073 -TC000

APPENDIX K

The following list of Ranger/launch vehicle integration action items indicates their final status as of May 21, 1965. The status of action items was published periodically throughout the program to obtain close coordination of effort.

NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHE
1	6/1/63	Lewis	Determine payload capability increment and reference trajectory using optimum Atlas pitch programming.	TWX, Himmel to AFSSD, 10/8/63. Ref. 9430-10-2 HSJ. To be incorporated on RA 8 & 9 Mar C.	GDA		Closed out 11/1/63
2	6/1/63	Lewis	Determine payload capability increment and reference trajectory using Atlas Booster steering.	1) GDA letter, Campbell to AFSSD, 9/18/63, Booster steering constraints 2) LMSC letter, Luskin to Himmel 10/3/63. Still under study for use on RA-6. 3) TWX Schurmeier to Himmel 1/7/64 recommending use of Booster steering on RA Blk III. 4) TWX LeRC to LMSC 9440-16-EHD- incorporate Booster Steering on RA-6	GDA	ASAP	Closed 1-13-64
3	7/29/63	JPL	Provide an official LMSC Dwg. List and Drawings for Ranger Block III Interface. Letter Schurmeier to Forney 7/29/63. Transmit Agena Vehicle Drawings for Ranger Block III (32 dwgs. total) to JPL Ltr. Schurmeier to Forney 8/20/63	1) Partially complete as JPL has received some dwgs. List dated 31 July, 63. 2) Letter, Schurmeir to Forney, 9/20/63 request for Agena Veh. 6008 drawings. 3) Handcarried dwgs. from LMSC on 11/6/63. 4) Ltr. Forney to Luskin 12/10/63 5) Close when list is rec'd by JPL approx. 3/30/64 per ltr LeRC to JPL, 9410-GMB 6) Ltr. Forney to LMSC 4/7/64, requests LMSC provide JPL with RA-7 Interface Dwg. List & reproducible dwgs. 7) Received 44 reproducible drawings 5/19/64. Transmittal letter and drawing list received 5/20/64.	Lewis/ LMSC	11/1/63	Closed 5/20/64
4	7/31/63	JPL	Approve JPL "Transportation Criteria" Document. Letter, Schurmeier to Forney, 7/31/63	TWX Himmel to Schurmeier 11/15/63 9410-11-9-GMB Lewis concurs.	Lewis/		Closed out 11/15/63
5	8/1/63	JPL	Issue Revision C to JPL Specification 30947, Ranger Block III Interface Specification.	In Reproduction, 10/22/63 "C" Revision dated 9/15/63 issued & transmitted to Lewis 11/7/63.	JPL	9/15/63	11/7/63 Closed out
6	8/6/63	JPL	Send 22 LMSC Drawings for Ranger Block III to JPL, TWX to Forney, 8/6/63.	Letter, Forney to Luskin, 9/21/63.	LMSC		Closed out 11/1/63
7	8/9/63	JPL	Transmit three (3) LMSC Technical Documents to JPL, Letter, Schurmeier to Forney, 8/9/63.	TWX, Schurmeier to Himmel MC-1040/ HMS/JTO, 11/12/63 Received reports at JPL 11/15/63	LMSC		Closed out 11/15/63
8	9/3/63	JPL	Coordinate official interface drawings Letter Schurmeier to Himmel 9/3/63 Note: JPL Dwg. 3180151 replaces 3180125	1) JPL received LMSC's Dwg. 1361287 (not released) 2) LMSC comments to JPL Dwg. 3180125 sent to Lewis 11/11/63, letter Luskin to Himmel 3) Letter Forney to Schurmeier 12/9/63 4) Item 3 answered by letter Schurmeier to Forney dated 12/30/63 5) Meeting at LMSC 1/14/64 placed 6 sub-action items on LMSC & 4 on JPL	Lewis/ LMSC	9/9/63	Closed 12/11/64

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NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHED
			(The JPL sub-action items have been closed. The LMSC sub-actions should be completed by 3/30/64 per letter LeRC to JPL 9410-GMB, 4/1/64)				
			JPL comments to UNRELEASED copy of LMSC Dwg. #1361287B transmitted 5/20/64, #LV-RA-90260				
9	9/7/63	JPL/ LMSC	Remove or modify cover plate on noise microphone in shroud prior to shipment to AMR.	1) Letter, Schurmeier to Himmel 10/9/63. 2) EJT #1255X written by LMSC for RA-6, 7, 8, & 9 per Himmel ltr. to Schuermeier 12/5/63 (9410 GMB)	Lewis/ LMSC	ASAP	Closed 12/5/63
10	9/7/63	JPL/ LMSC	Install vertical skid ramps near Foot A and E on Adapter prior to shipment to AMR.	1) Letter, Schurmeier to Himmel, 10/9/63. 2) TWX, Himmel to LMSC directed to install ramps per ECP #3800-66 3) App'd 10/8/63 for RA-6,7, 8 & 9 per ltr. Himmel to Schurmeier 12/5/63.	Lewis/ LMSC	ASAP	Closed 12/5/63
11	9/7/63	JPL/ LMSC	Correct LMSC Drawing 134 2539B and hardware before shipment to AMR. Shield return Pin A was not connected to Pin IF on the umbilical receptacle.	1) LEO 1342539B has been written. Revised dwg. to follow per ltr. Himmel to Schurmeier, 12/5/63 2) Letter Forney to Luskin 12/10/63.	Lewis/ LMSC	ASAP	Closed 12/5/63
12	9/7/63	JPL/ LMSC	Increase the existing clearance of 0.020 inch between Solar Panels and Shroud.	1) Letter, Schurmeier to Himmel 10/9/63. 2) LMSC is to install "Clearance Cups" at 4 points to clear Solar Panel Hinges per ECP #3800-69, 11/6/63 3) Closed per letter Himmel to Schurmeir 12/5/63	Lewis/ LMSC	ASAP	Closed 12/5/63
13	9/7/63	JPL/ LMSC	Check the locations of Spacecraft separation linear potentiometers.	1) LMSC's Dwg. 1361287 indicates Pots off center of S/C Plates. 2) "All problems resolved" per ltr Himmel to Schurmeier, 12/5/63 - no change to be made.	JPL/ LMSC		Closed 12/5/63
14	9/7/63 LMSC	JPL/ LMSC	Revise LMSC Specification 1415559A.	1) "B" change of this spec. was available and used for RA-7 Match-Mate Tests, but there are still further changes to be made as detailed in the RA-7 Match Mate Summary Meeting Report No. 311-697, Item 4. 2) LMSC to revise spec. per ltr Himmel to Schurmeier, 12/5/63 and Forney to Luskin 12/10/63. 3) Closed per ltr, Himmel to Schurmeier 1/3/64, 9410-GMB	Lewis/ LMSC	ASAP	Closed 1/3/64

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NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHE
15	9/7/63	JPL/ LMSC	Specify the clearance, in LMSC Spec. 1415559, between the TV Micro-switch and the pad.	See remarks under Item 14.	Lewis/ LMSC	ASAP	Closed 1/3/64
16	9/7/63	JPL/ LMSC	Install springs to twist-off fittings for RA-6 prior to shipment to AMR. Install springs prior to all future Match Mate tests.	Springs have been instld. per ltr. Himmel to Schurmeier 12/5/63.	Lewis/ LMSC	ASAP	Closed 12/5/63
17	9/7/63	JPL/ LMSC	Take proper action to reduce length of cabling to spin-off fittings. Cables are six inches too long and action must be taken prior to shipment to AMR.	LMSC has issued DCN 1342546 per ltr. Himmel to Schurmeier 12/5/63.	Lewis/	ASAP	Closed 12/5/63
18	9/7/63	JPL/ LMSC	Transmit LMSC Drawings showing microphone installation in shroud 1361303 1360819 1361306 1461485		LMSC		Closed out 11/1/63
19	9/7/63	JPL/ LMSC	Include a dust protector for bottom of adapter for RA-6 at AMR and for subsequent Match Mate tests.	RA-7 adapter received with dust protector at JPL for Match Mate tests. Only two (2) of these covers are in existance. They will be kept at AMR for use there. They have been tried on all adapters and dolly combinations and will not be required for RA-8 and 9 M-M Tests.	LMSC		Closed out 11/20/63
20	9/7/63	JPL/ LMSC	Distribute pictures of RA-6 Match Mate tests	Distributed 9/13/63	JPL		Closed out 11/1/63
21	9/7/63	JPL/ LMSC	Investigate clearance of pin-puller monitor switch bracket and rotary coax housing clamp bolt head.	No further action required, 10/18/63	LMSC/ JPL		Closed out 11/1/63
22	9/7/63	JPL/ LMSC	Evaluate losses between omni antenna and shroud coupler which are two db greater than expected.	Losses are acceptable.	LMSC/ JPL		Closed out
23	9-10-63	Lewis	Monitor G.E. Guidance Retrofit program	1) TWX, Lewis to JPL, 10/3/63 2) TWX, Himmel to Maj. Parrish No. 9421-10-3-PFM	Lewis		Closed 1-3-64

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NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHE
24	9/13/63	JPL	Complete RA Block III Separation and Static Tests prior to 11/1/63 TWX Shurmeier to Himmel 9/13/63 TWX Shurmeier to Forney 9/20/63 TWX Shurmeier to Forney 9/24/63	Separation tests complete S/C Mock-Up to LMSC 10/4/63 LMSC to reply to TWX, Himmel to Luskin 10/14/63. TWX Luskin to Himmel, 10/21/63 All tests completed 11/15/63		Closed out 11/15/63	
25	9/13/63	JPL	Perform RA-7 Match Mate Tests LMSC Hardware to arrive at JPL by noon of 10/15/63	Tests completed, Hardware shipped back to LMSC 10/21/63 See Report JPL No. 311-697	LMSC/JPL	Closed out 11/15/63	
26	9/13/63	JPL	Approve use of LMSC RA-7 Adapter and Shroud by JPL through 10/21/63 at JPL for Dummy Run.	Closed out.	LMSC	10/9/63	10-21-63
27	9/15/63	JPL	Transmit three copies of Agenda D	Copies received	LMSC	Closed out	
28	9/20/63	JPL	Qualify Ranger Block III Destruct System Command Receiver	TWX, Himmel to LMSC, 9/20/63. Testing 10/15/63. JPL needs documentation by 11/1/63 toforward to range. TWX Himmel to Schurmeier 11/8/63 9410-11-5GMB. See Flt. Term Sys. Rprt. LMSC/A060673-B	LMSC	Closed out 11/8/63	
29	9/27/63	Lewis	Task No. 9, NAS 3-3805 Standard L/V Requirements and Restraints Document - Development of Standard Document by LMSC	Close per ltr. Himmel to Schurmeier 1/3/64, 9410 GMB	Lewis/ LMSC	Closed out 1/3/64	
30	9/27/63	Lewis	Task No. 10, NAS 3-3805 LMSC to study and determine partial derivatives of payload with respect to various error sources.	Close per ltr. Himmel to Schurmeier 9410-GMB , 1/3/64	Lewis/ LMSC	Closed out 1/3/64	
31	10/2/63	Lewis	Investigate use of an additional Agena Restart Timer.	1) Letter Luskin to Himmel 11/21/63 2) Stop investigation per TWX Himmel to Luskin, 12/12/63, 9410-12-22 GMB 3) LeRC ltr. 9410-GMB 1/3/64		Closed out 1/3/64	
32	10/2/63	JPL	Request for use of Agena Telemetering Antenna TWX, Schurmeier to Himmel	TWX, Himmel to LMSC, 10/8/63 Letter, Forney to Luskin 10/8/63 Antenna returned to LMSC 10/29/63		Closed out	
33	10/4/63	JPL	Change S/C Back-Up Timer Bracket on the Adapter. Ltr. Schurmeier to Himmel 10/4/63	1) W. Lane, JPL discussed with G. Bode 10/7/63 2) Holes to be enlarged and adjust bracket in accord with change mentioned under Item 14. Chg. Order #36 dtd 10/23/63. 3) Closed per ltr Himmel to Schurmeier 12/5/63	Lewis/ LMSC	Closed out 12/5/63	
34	10/9/63	JPL	Transmit JPL Decals to L/V agencies	Hand carried to Forney/LMSC Mailed to Von Der Wische/GDA	JPL	Closed out 10/11/63	
35		Lewis	Ship Atlas 199D to AMR	1) Revised per TWX 9421-10-30-PFM from Lewis to WONASA/SSD dtd. 11/1/63. 2) Arrived at AMR per ltr Himmel to Schurmeier 12/5/63	Lewis/ GDA	Closed out 11/31/63	

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NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHED
36		Lewis	Ship Agena 6008 to AMR	Arrived at AMR per ltr Himmel to Schurmeier 12/5/63			Closed 11/22/63
37		Lewis	Qualify Agena "Eye Ball" Sun Detector for RA-6	1) Lockheed Electronics qualified in Aug. 63. Two successful flights. 2) Closed per ltr. Himmel to Schurmeier 12/5/63			Closed 11/22/63
38	9/26/63	JPL	Request for Lewis approval of Ranger Bl. III PDP per letter Schurmeier to Himmel, 9/26/63	Lewis' Approval Rec'd 10/31/63			Closed 10/31/63
39	10/8/63	Lewis	LMSC Report summarizing results of RA-6 Match Mate Tests. Ltr. Schurmeier to Himmel 10/8/63	1) Mentioned in LMSC Monthly Progress Report 2) LMSC issued and JPL rec'd copy 12/12/63 3) LeRC ltr 9410-GMB 1/3/64	Lewis/ LMSC		Closed 12/12/63
40	11/ 1/63	Lewis	TWX, Request for Detail Dwgs. on S/C Back-Up Timer	Data transmitted by letter to Himmel from Schurmeier dated 11/14/63	JPL		Closed 11/14/63
41	11/ 4/63	JPL	TWX Request for V.H.F. Antenna, C Band Beacon Antenna, and Shroud Cable Assembly	TWX, Himmel to Schurmeier requests JPL purchase subject items for permanent retention 11/15/63 JPL attempting to get quotes from LMSC	Lewis/ LMSC		Closed 11/15/63
42	10/24/63	JPL	Letter, Request for Temporary use of FPS-16 Radar Transponder.	1) TWX, Himmel to LMSC directing LMSC to furnish to JPL for 3 wks and return by 12/15/63. 2) LeRC TWX to LMSC 9421-11-4-RWM 11/15/63. 3) LMSX TWX Luskin to Himmel 12/3/63 A 377786. 4) Ltr. Himmel to Schurmeier 12/13/63 9410 GMB 5) Ltr. Schurmeier to Himmel 12/23/63 requesting data in lieu of transponders. 6) TWX LeRC to LMSC 9410-1-7 GMB 1-9-64 requests LMSC to send data. 7) Qualification Test Unit Transponder hand-carried to JPL 1/14/64 8) TWX LeRC to LMSC 9410-1-28 GMB approving shipment. 1/21/64 9) JPL could not make transponder operate. Shipped back to LMSC, c/o J.P. Stewart, 2-10-64 for repair. 10) LMSC checked operation which was satisfactory. Reworked to trigger with a single pulse and returned to JPL 2/28/64. 11) JPL getting operating instructions from LMSC 4-8-64. 12) Close per ltr. LeRC to JPL, 9410-GMB, 4/1/64.	Lewis/ LMSC		Closed 4-1-64

JPL 1698 NOV 63

NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHED
43	11/ 5/63	Lewis	Ltr. Request Effects of Removal of Tradewinds Cooling Sheath2 minutes prior to lift-off.	1) Ltr. Luskin to Himmel 11/12/63, LMSC A602012 2) JPL reply ltr. Schurmeier to Himmel 12/3/63	JPL		Closed 12/3/63
44	10/17/63	JPL	RA-7 M-M Summary Mtg. JPL Report No. 311-697				
			SUB: Item 1. Determine if Spring Constant Measurement is necessary. on RA-8 and 9.	Yes, it is necessary, ref. ltr. Schurmeier to Himmel 12/2/63.			Closed 12/2/63
			SUB: Item 3. Enlarge holes for backup timer bracket for adjustment. (See Action Item #33)				Closed 12/5/63
			SUB: Item 4 (Same as Action Item No. 14.)				Closed 1/3/64
			SUB: Item 5 Provide more clearance for High Gain Antenna	Still being investigated per letter Himmel to Schurmeier, 1/3/64, 9410-GMB	Lewis/ LMSC		
			SUB: Item 6 Provide for positive clearance of Solar Panel Hinges with Shroud Liner	Same status as Sub Item 5	Lewis/ LMSC		
			SUB: Item 7 (See Action Item No. 9		Lewis/ LMSC		Closed 12/5/63
			SUB: Item 8 Replace Accel. & Amp. Assem. on Adapter	Same status as 5.	Lewis/ LMSC		
			SUB: Item 13 Inspect and clean plugs on adapter.	Same status as 5	Lewis/ LMSC		
45	11/12/63	JPL	Request for LMSC documents: Ltr. Schurmeier to Forney 11/12/63: a) A376344 Prog. Control Document b) 447969-B Agena Radio Freq. Interference Specification.	1) Still being investigated per ltr. 2) TWX JPL to Forney 1/23 64 LV 90035	Lewis/ LMSC	12/ 1/63	Closed 1/27/64
			Note: Request for Item a, "Program Control Document," cancelled by JPL at 3-20-64 Interface Meeting. Close per ltr. LeRC to JPL, 9410-GMB, 4/1/64. Item b, Spec. #447969B was received by JPL 1/27/64.				
46	11/ 1/63	JPL	Incorporation of Inspected Diodes on Booster Equipment	Lewis TWX 9400-11-1-CCC Himmel to SSD/Wolfsberger 11/4 Lewis TWX 9400-11-3-SCH Himmel to SSD/Parish 11/12 Support of RA-6	Lewis		Closed 11/12
47	10/15/63	JPL	LMSC Update Spacecraft/Launch Vehicle	1) Under investigation, ref. ltr. Himmel to Schurmeier 1/3/64, 9410 GMB 2) Being updated by LMSC per ltr. Himmel to Schurmeier 2/12/64, 9410 GMB 3) JPL transmitted copies of JPL schedule as inputs to LMSC per ltr Schurmeier to Forney, 2-14-64, Lv 90078 4) Ltr. LMSC to LeRC, A603321-91-11 3-6-64 agreeing with JPL dates 5) Ltr. LeRC to JPL, 9410-GMB 4-1-64 requesting this item to be closed.	Lewis/		Closed 4/ 1/64

JPL 1695 NOV 63

NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHE
48	11/18/63	JPL	Change Telemetry Measurement Channel 18 Vibration Measurements on S/C instead of Shroud for RA-8 & RA-9. Ltr. Schurmeier to Himmel 11/18/63	1) Being investigated per telecon, Lane to Bode 12/10/63 2) Ltr. Himmel to Schurmeier 1/3/64, 9410-GMB 3) TWX LeRC to JPL 1/6/64, 9410-1-3-GMB 4) TWX JPL to LeRC 1/8/64, #00019 Answer to questions posed in Item 3. 5) Letter Forney to LMSC, 9460; WCA 1/20/64. Can LMSC support this? 6) Ltr. LeRC (Eski) to LMSC 1432, 1/23/64 directs LMSC to comply. 7) TWX, LMSC to LeRC, 2/7/64, LMSC; A 602840 8) Close per ltr. Himmel to Schurmeier 2-12-64 9410-GMB	Lewis/ LMSC		Closed 1/28/64
49	12/ 2/63	JPL	Resolve Schedule for RA-8 & RA-9	1) LMSC Ltr. to Forney 11/15/63, subj. "S/C Adapter Contamination" 2) TWX LeRC to JPL, 9410-12-29 GMB 12/17/63 3) Ltr. JPL to LeRC, 1/9/64 #00020, answering questions posed in Items 1 & 2 4) Ltr. LeRC to JPL, 9410-GMB, 1/24/64, Schedule and Procedure resolved pending concurrence. 5) TWX JPL to LeRC, LV 90055, 2/3/64 giving JPL concurrence 6) Ltr. JPL to LeRC transmitting revised procedure, 2/5/64, LV 90066. 7) Ltr. LMSC to LeRC giving LMSC concurrence, 2/14/64, LMSC A377922	Lewis/ LMSC	1/15/64	Close 2-14-64
50	11/29/63	LeRC	Agena Project Electro Magnetic Interference Test Policy - LeRC solicits comments, ltr 11/29/63 Himmel to GSFC, LeRC, JPL, LMSC	Ltr. JPL to LeRC 1/24/64, LV 90038, giving combined Mar. C and Ranger project comments.	JPL		Closed 1-24-64
51	11/19/63	JPL	Request for LMSC documents on Flt. Instrumentation Evaluation for RA Blk III per TWX RA-119 Schurmeier to Forney 11/19/63	All documents received at JPL 12/19/63	Lewis/ LMSC		Closed 12/19/63
52	12/16/63	JPL	TWX, JPL to LeRC RA III-122/HMS/HJM 12/16/63. Subject: Modification of' Ranger/Agena Test Adapter 6006 to Flight Configuration (EM 550A)	1) Letter Forney to LMSC 12/9/63, Subj. Ranger Blk III Adapter 6006. 2) Letter LMSC/A377820 to Forney 12/31/63 3) TWX, JPL RA III-127 to LMSC 1/8/64, Request for instrumentation Dwgs. by 1/13/64 4) Ltr. Forney to James 1/27/64 Adapter reworked. 5) Reworked adapter #EM 550A received at JPL 1/31/64. Dwgs. requested in #3 above also received.	Lewis/ LMSC		Closed 1/29/64
53	12/24/63	JPL	Request for better copies of 4 LMSC dwgs. and comments on obtaining reproducible LMSC dwgs. Ltr. JPL to Lewis 12/24/63	1) Ltr. LeRC to JPL 2/12/64, 9410-GMB Under investigation 2) Ltr. LeRC to JPL 3/2/64, LMSC has been requested to furnish high quality reproducibles. 3) Close per ltr. LeRC to JPL, 9410-GMB, 4/1/64	Lewis/ LMSC		Closed 4/1/64

JPL 1895 NOV 63

NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHED
54	12/26/63	JPL	TWX JPL to Lewis, RA III-124-HMS/WJL 12/26/63. Request for "Confirmation of Mass Properties" as related to S/C Separation	Ltr. 9422-RNR, Lewis to JPL 1/15/64 S/C Separation performance O.K.	Lewis		Closed 1-20-64
55	1/22/64	JPL	TWX JPL to Lewis, LV 90021 Request for LMSC documents: a) RA Bl.III Dynamic Instrum.(3 doc) b) Tele. Instr. Schedules (RA 6,7,8&9) c) Tele. Charts (4 docs)	All documents have been received by JPL 4/7/64	Lewis/		Closed 4-7-64
56	1/23/64	JPL	Request for LMSC documents TWX, JPL to Forney LV 90034 a) EMI Control Spec for AGE #920493 b) A085125 Sys. Design Spec for Atlas Booster and Agena D.	a) Correct number to 447969B - copy received at JPL b) Documen is obsolete. Close per LeRC ltr 9410-GMB to JPL 6/8/64	Lewis/ LMSC		Closed
57	1/21/64	JPL	Request for documents Ltr JPL to LeRC - LV-90025 a) LMSC A602502B Conditions for Launch and Hold Limitations for Agena B Vehicles b) GD/A 27-86013-1 "Atlas Test Parameters for Factory and AMR".	1) Ltr Himmel to Kindt 2/11/64 9401-GTH, requesting item b 2) Ltr Kindt to Col. Brandenberry, SSD, 2/13/64, requesting item b. 3) Ltr LeRC to JPL 9410-GMB, 6-8-64 cause of delay being investigated 4) Doc received 5-7-64 NOTE: The equivalent document for Agena D was received by JPL 3-30-64 (LMSC/A60343) 5) JPL has not received item b. 6) Not yet received (2-8-65)	Lewis/ LMSC AFSSD		Never closed because of 5)
58	1/23/64	LeRC	TWX LMSC to LeRC LMSC/A37787 1/23/64, asking change in "base band coupler input impedance" constraint in JPL Spec. RCO-30947-DTL-C	1) TWX, JPL to LeRC #LV90043, 1/28/64 granting waiver on RA-6 and RA-7. 2) TWX, JPL to LeRC #LV90087, 2/19/64 stating that JPL will give answer by 3/9/64 for RA-8 and 9. 3) TWX JPL to LeRC #LV 90124, 3/10/64, stating that impedance not be changed from JPL Spec. 4) TWX, LeRC to LMSC, 9410-3-19 GMB 3/12/64, directs LMSC to comply to Spec.	LeRC/ LMSC		Closed
59	2/13/64	JPL	a) TWX JPL to LeRC - LV 90073,2/13/64 Request for Data Reduction & Analysis of RA 6 Dynamic Measurements	1) Telecon Bode & Lane 2/18/64 2) Telecon Bode & Lane 3/ 9/64 LMSC Prel. Cost Estimate - $57,000 3) TWX, JPL to LeRC #90122 3/9/64 clarifying scope of request with no increase in contract cost. 4) LMSC 45 day report #A603322 Received 4/1/64 plus GDA Report #GDA/BKF64-002 5) Close per letter LeRC to JPL 9410-GMB, 4-1-64	LeRC/ LMSC		Closed 4-1-64
60	2/20/64	JPL	1) TWX JPL to LeRC - LV 90091, 2/20/64, Request for increase in range of tele. instruments on Channel 17 for RA 7, 8, & 9 2) TWX, JPL to LeRC - LV 90140 3/13/64 Additional request for change to radial vibration meas. instead of axial for 7, 8 and 9.	1) TWX LeRC to JPL, 9410-3-7-GMB 3-5-64 Requests this item on agenda for 3/19/64 Data Review Meeting. 2) TWX,LeRC to JPL 3/3/0/64,9410-3-44-GMB 3) TWX, LeRC to LMSC 3/3/0/64 - 9410-3,45-GMB directing LMSC to change range for RA-8 only. RA 7 & 9 to remain axial measurements			Closed 3-30-64

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NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHED
61	2/ 6/64	JPL	TWX, JPL to LMSC - LV 90067, 2/6/64, Request for TWANG data for Ranger 6 Agena Accel. pickups. Oscilloscope pictures	1) Telecon, Armistead/Ofer, 2/25/64 data will be forwarded soon 2) Ltr. LMSC to Forney, 3/31/64, A377981 transmitting 6 oscillograph records 3) Telecon, Armistead/Lane 4/9/64, data to be mailed by 4-8-64 4) Received at JPL, 4/10/64, Ltr. 9460 - WCA			Closed 4/10/64
62		JPL	Provide sufficient clearance between Shroud Liner and S/C Solar Panel Hinges (slight interference was evident on RA-6 at AMR on 1/24/64	1) JPL transmitted revised prints #J3159347A & J3180151B to LMSC for investigation per letter Schurmeier to Forney 2/5/64 - LV 90065 2) 2-20-64 Ltr. Forney to Shoenhair requesting comments on clearance problem by 2-28-64 3) 3/12/64, Ltr. LMSC to LeRC, LMSC/A 377992 stating that they believe no shroud mods are justified at this time. 4) Close per ltr. LeRC to JPL, 9410-GMB 4/1/64	LeRC LMSC		Closed 4/1/64
63	2/25/64	JPL	Request for Doc. LV 90103 TWX Schurmeier to LeRC, LMSC Dwgs. a) 135-2961 Bracket b) 135-4943 Bracket	Received 3/5/64. Handcarried from Armistead by J. Shaffer Completed	LeRC/ LMSC		Closed 3-5-64
64	2/27/64	JPL	TWX, JPL to LeRC #LV 90106, 2/27/64 Request for investigation of Ranger 8 Adapter to determine reason for soft "Spring rate" on S/C Foot "B" area.	1) TWX LeRC to JPL 9410-3-3GMB 3/4/64 requesting more info. from JPL as a result of the JPL tests 2) TWX, JPL to LeRC, LV 90134, 3/12/64 giving results of evaluation tests and requesting meeting at LMSC 3-20-64 3) TWX, LeRC to JPL 4/3/64, 9410-4-4-GMB Concurring with JPL proposals. 4) TWX, JPL to LeRC 3/31/64, LV-RA-90134 re: using STM S/C for repeat tests of spring constants. 5) Ltr. JPL to LeRC, 3/31/64, LV RA 90161 re: possible future tests 6) TWX, LeRC to JPL, 4/3/64, 9410-4-GMB concurring with JPL proposed tests	LeRC/ LMSC		Closed 4-3-64
65	3/6/64	JPL	TWX JPL to LMSC 3/6/64 Request for 5 Dwgs. LV-RA-90118: 1461970 Connector, S/C Right Angle 1396019 Dialectric window 1397133 Probe 1397134 Cavity Assembly 1342539 Wiring Diagram	1) TWX, LeRC to LMSC, 9410-3-18 GMB, 3/12/64 requesting LMSC to transmit two print copies 2) Ltr. LMSC to JPL, A603533 4/7/64 transmitting all useful dwgs.			Closed 4-7-64
66	3/11/64	JPL	Ltr. JPL to LeRC, LV 91029, Request for reproducibles on 8 dwgs. a) 6009 1) J1359965 A 2) K1361510-A 3) J1361512-A b) 6008 1) J1359962-A 2) J1347331 c) 6009 1) J1363689 2) B1363688 3) K1363687	NOTE: One Reader Printer copy of each received 3/6/64 with promise of reproducibles to follow.			Closed 3-6-64

NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHE
67	3/16/64	Joint	Transmittal letter, JPL to LeRC LV-RA-90143, RA-8 Match Mate Report #311-705.		JPL		Closed
			Sub Item #1 - JPL will write proposed deviations to LMSC Spec. J141559 for use of "Yellow Dog" Hoisting Fixture.	Sub Item #1 - Copies of revised JPL Procedure 3R 102.01 (with proposed deviations) mailed 12/8/64. Close			
			Sub Item #2 - LMSC to check location of potentiometer near foot F. Problem failure report #102877	Sub Item #2 - FEDR #214688 was written and new bracket installed. Close per LeRC letter to JPL, 9410-GMB 6-8-64.			
68	5/14/64	JPL	Request for Step Force Test (TWANG) Data for RA-7, 8 & 9, JPL letter LV 90241 to LeRC, 5/14/64	1) TWX, LeRC to LMSC, 5/26/64 Ref. 9440-5-10-JCE, requesting test data. 2) Data for RA-7 received 10/30/64 and returned to W. Trask LMSC 10/31/64. 3) Data needed at JPL for RA-8 & 9 4) RA-C (RA-8) data received RA-D (RA-9) data expected about 2/15/65	LeRC/ LMSC		Close
69	5/14/64	JPL	Study of the possibility of contamination from Atlas retro-rockets. JPL TWX LV - 90246, 5/15/64 to LeRC	LeRC TWX to JPL 9440-5-KAF, 5/20/64 states that a preliminary LMSC study is being reviewed by LeRC. JPL has not received the report. LeRC transmitted LMSC letter A603063 to JPL, but this referred to Mar C only. JPL requests verification that the letter pertains to Ranger also. (TWX received; 9410-10-1-19-GMB. Close	LeRC/ LMSC		Closed 1-25-65
70	6/23/64	JPL	Request for GDA documents 1. #BKJ 63-001-4/11/63 (Classified) 2. 63-0014-5/10/63 (Classified)	Items 1 & 2 received 7/7/64	LeRC/ GDA	ASAP	Closed
71	6/25/64	JPL	Request for LMSC Dynamics Report on RA-6 Flight. Addendum to 45-day report #A603322, 1/25/65 (dated)	1) Telecon with LeRC 6/25/64 confirms JPL will receive copies when report is published. 2) JPL has not received the addendum. 3) Received Feb.10, 1965 LV-1603	LeRC/ LMSC		Close 2-10-65
72	7/ 1/64	LeRC	Request for investigation of cut Atlas coax cable on 250D. Recurring problem at ETR. Reference RA-7 Daily Activity Report #8	Action Item #15 in Minutes of RA-7 Postflight Analysis Meeting. LeRC TWX 9410-10-3-GMB recommends closing, however JPL requests more information. Refer to Action Items 73, 79 and JPL Ltr RA-LV-90653 See LeRC ltr date 1-28-65 LV-01580	LeRC		Close 2-4-65
73	8/13/64	JPL	Determine mounting system to be used for GE Package.	Action Item #9 Minutes of Postflight Analysis Meeting. JPL requests identification of which method will be used and whether modifications to the Atlas are necessary. Info per telecon, G. M. Bode, LeRC, and W. J. Lane, JPL on 11/16/64 - GE mount using rubber isolators at each corner will be used. Atlas vehicles for RA-8 & 9 have been modified. What is effect on flexible waveguide? Ref. to Action Items 72, 79 and JPL Ltr. RA-LV-90653.	LeRC		Close
74	8/13/64	JPL	Determine cause of Agena telemetry dropout at Atlas staging.	1) Action Items #17 Minutes of Postflight Analysis Meeting. 2) Telemetry did not drop out on RA-6 flight; is this a unique case? 3) Refer to memo to Schurmeier from Ir. Hersey. Subject:"Effect of booster staging on Ranger Telemetry Signals" dated 18 Jan 1965.	LeRC		Closed 1-18-65

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NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHED
75	8/13/64	JPL	Reduce the high temperature under the shroud. a. The Agena air conditioner coil apparently freezes up under adverse weather conditions. b. Leaks exist between the adapter and the S/C compartment.	Action Item #18 - Minutes of Post-flight Analysis meeting. a. JPL was requested to waive temperature limits for the RA-7 flight. b. The JPL purging system, which normally operates at a pressure of ½ inch of water, actually operated at a pressure of about 4 inches of water. Pressure dropped when the Agena air co.ditioner was turned off. c. Closed per JPL (J Long) recommendation.	LeRC		Closed 12/11/65
76	8/13/65	JPL	Improves umbilical door closure on Adapter	1) Action Item #19 Minutes of Post-flight Analysis Meeting 2) Adapter umbilical door closure may have been faulty, as indicated in letter RA-LV-90540 from JPL to LeRC dated 30 Sept. 1964. 3) RA-9 umbilical door did not close. Ref. TWX to LeRC on 4/1/65 (RA-LV-90786) 4) See LeRC recommendations regarding this door at RA-9 Post Flight Meeting held at JPL 4-21-65	LeRC		Closed with further recommendations 4/25/65
77	10/16/64	JPL	Determine if RA-8 Launch Vehicle squibs will meet the range requirements or if a waiver is required.	1) Action Item #6 Ranger Quarterly Review 10/16/64 2) Permission to launch will not be specifically required for the Atlas boosters for RA-8,9 per LeRC TWX 9410-10-31-GMB 3) LeRC has requested deletion of the requirement for submitting data on the Agena, but no decision has been reported. 4) Close per LeRC letter 9410 GMB dated 1-22-65 (LV-1558)	LeRC		Closed
78	10/16/64	JPL	Determine how to prevent flaking of internal surface of the shroud. What is the decision on sonic cleaning and on sealing the surfaces with sprayed materials?	1) Action Item #8 Ranger Quarterly Review 10/16/64 2) Shroud is presently cleaned in accordance with LMSC Spec LAC0170 3) Close per LeRC ltr 9410-GMB dated 1-22-65,LV-1558.			Closed
79	8/13/64	JPL	Determine cause of pulse width failure on #1 backup GE airborne equipment for RA-7	1) Action Item #14 Minutes of Post-flight Analysis Meeting Pulse width failure may be related to trouble with coax cable (refer to Action Item #72,73, and JPL ltr. RA-LV-90653 2) Ltr. from LeRC (LV-01580) Ref. 9421-RW17 dated 1/28/65. OK to close			Close 2-4-65
80	8/13/64	JPL	Resolve differences in Atlas and Agena propellant margins for RA-7; predicted vs. actual.	1) Action Item #29 Minutes of Post-flight Analysis Meeting. Refer TWX from LeRC 9410-10-3-GMB. Why was Agena first burn too long? 2) This statement is apparently in error. LMSC report A-605114 states that both first and second burn parameters indicated normal performance throughout.	LeRC		Closed
81	10/ 6/64	JPL	Change accelerometer sensitivity for the PL 20 measurement from ±15g to ±25g. Ref JPL letter to LeRC (RA-LV-90546) dated 10/6/64)	1) LeRC TWX to LMSC (9410-10-8-GMB) LMSC was requested to change the measurement range in above TWX 2) Telecon between G.M. Bode, LeRC, and W.J. Lane, JPL, indicated that this item has been taken care of. Close.	LeRC		Closed

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NO.	DATE INITIATED	INITIATED BY	ACTION	STATUS	ACTION BY	DATE REQUIRED	DATE ACCOMPLISHED
82	11/16/64	JPL	Determine reasons for not incorporating JPL comments on LMSC Dwg. #1361287B.	1) LMSC Dwg. released with unresolved JPL comments remaining after coordination. (Refer to Action Item #8) 2) "C" change of this Dwg. was received by JPL on 2-15-65 (LV-01612) and is OK. Close	LeRC		Closed 2-15-65
83	11/12/64	JPL/LMSC	Correct galled condition of threads on high gain antenna snubber on Adapter #6006 (for RA-8) Ref. JPL letter to LeRC (RA-LV-90610) dated 11/12/64	1) Action Item No. 2 at summary meeting for rematch mate tests of RA-8. 2) Was corrected/LeRC letter 9410-GMB dated Jan. 22, 1965 (LV-1558)	LeRC		Closed 1-22-65
84	11/25/64	JPL	Verify that transformers in autopilot canisters in Atlas boosters 196D and 204D have been approved; notify JPL of date of approval. Ref. JPL letter to LeRC (RA-LV-90623) dated 11/25/64.	Close per LeRC Letter 9410-GMB dated Jan. 22, 1965 (LV 1558)	LeRC		Closed 1-22-65

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REFERENCES

1. JPL Space Programs Summary No. 37-31, Vol. VI, January 31, 1965, page 1

2. JPL Technical Report No. 32-241 (Classified), "The Ranger Project: Annual Report for 1961 (U)", pages 1 and 2, 84 through 94 inclusive, downgraded to unclassified by authority of EPD-20 dated 2 January 1961

3. JPL Technical Report No. 32-700, Ranger VII, Part 1, Mission Description and Performance, December 15, 1964, page 9

4. JPL Space Programs Summary No. 37-9, Vol I, June 1, 1961, pages 4 through 10

5. JPL Space Programs Summary No. 37-15, Vol. VI, Space Exploration Programs and Space Sciences, June 30, 1962, pages 3 through 10

6. JPL Minutes of Meeting of NASA, MSFC, SSD, and JPL Concerning Ranger and Mariner Program Plans at JPL on 23 and 24 January 1963, H. Margraf and G. Haddock

7. JPL Document RA-III Launch Vehicle Review, Report of the JPL Review Board, Harry J. Margraf, dated July 1, 1963

8. NASA Letter from NASA Agena B Division (WDZJA), Hq Air Force BMD, Los Angeles, to JPL, MSFC, and GSFC, dated 30 August 1960, "Action Upon Completion of Task Assignment Directives"

9. Lockheed Letter LMSC/A052710 from H. T. Luskin to AFSSD (SSVZR) Attn. Major J G. Albert, dispatched 18 July 1962, "Status of the NASA TADs"

10. JPL IOM from B. Wada to E. Chow dated 7 June 1961, "Lockheed-JPL RA-I Static Test"

11. LMSC Document A-601118, Job Request, dated 15 February 1961, "Static Test-10205 Forward Section and Nose Cone"

12. JPL Analysis Number ST-1.01.20, dated 2 August 1963, "JPL Instrumentation Requirements, Static Test- LMSC"

13. LMSC Document A630903, Job Request dated 22 August 1963, "Static Test-Spacecraft Adapter and Forward Section, (Ranger Block III)"

14. JPL Report No. 158, dated 14 February 1964, entitled "Static Test - Ranger Block III Spaceframe Mounted on Agena Adapter and Forward Section"

15. LMSD Document LMSC/447172/62-91, dated 10 August 1960, "Final Report of NASA TAD 002 Study, Agena/Spacecraft Shroud Separation"

16. LMSD Document LMSD/369987, dated 23 September 1960, "Supplementary Study of Agena/Spacecraft Shroud Separation"

17. LMSD Document LMSC/362183/62-41, dated 14 June 1960, "Structure Study SS/204, Spacecraft-Agena Separation for NASA-Ranger Flights"

18. Lockheed Aircraft Corporation, Report No. 15314, dated 25 October 1961, "Nose Cone Separation Test"

19. Lockheed Report 15315, not dated, "Spring Mechanism Tests"

20. Lockheed Aircraft Corporation, Report No. 15316, dated 27 November 1961, "Spacecraft Separation Test"

21. JPL Conference Report No. 311-686, dated 1 August 1963, "Separation Tests", W. J. Lane

22. LMSC Interdepartmental Communication SPL-148, dated 23 October 1963, "Ranger Block III Separation System Performance"

23. JPL Report No. 311-633, Telecon initiated by L. C. Montgomery, JPL, dated February 8, 1961

24. JPL Interoffice Memo from W. Hough to Distribution, dated March 21, 1963, "Structural Vibration Tests of Ranger Block III Mounted on LMSC Adapters"

25. JPL Test Report No. DT 1.00.20, dated October 9, 1963, "Preliminary Composite Dynamic Test Report - Ranger 9 MTM Mounted on LMSC Adapters", prepared by W. Hough

26. JPL Interoffice Memo from A. P. Bowman to W. S. Shipley, dated 20 April 1961, "LMSD Spacecraft Separation Pinpuller Actuation Test Results"

27. JPL Interoffice Memo ERG No. 142, from A. R. Hoffman to A. P. Bowman, dated 16 August 1962, "Ranger 5 Pyrotechnic Tests"

28. JPL Interoffice Memo 3152-62, from A. Hoffman to A. Bowman, dated 31 October 1963, "Ranger 6 Pyrotechnic Test"

29. Lockheed Letter LMSC/A602062, Luskin to Forney, 5 November 1963, "Ranger Block III - Contract NAS-3-3800 Spacecraft Adapter Contamination"

30. JPL Interoffice Memo 3152-82, from A. Bowman/A. Hoffman to A. Wolfe/ R. Crabtree, dated 20 December 1963, "Pyrotechnic Tests on Spacecraft Adapter"

31. JPL Interoffice Memo 3152-206, from A. Hoffman to A. Bowman, dated 10 July 1964, "Ranger Block III PTM Pyrotechnic Tests - 1963 (Pre RA-6)"

32. JPL Interoffice Memo 3152-210, from A. R. Hoffman to A. P. Bowman, dated 22 July 1964, "Ranger Block III PTM Pyrotechnic Tests"

33. JPL Letter, D. W. Hughes, JPL, to L. C. Maurer, LMSD, dated February 14, 1961, Subject: "RFI Setup Procedure for Compatibility Test"

34. LMSD Document No. 1317953, "Radio Frequency Compatibility Test"

35. LMSC Procedure ETR-133187A, dated 25 June 1964, "Ranger Block III Combined RF Radiation/EMI Test"

36. LMSD Document SSN-T61-22 (LMSD-448321) dated 9 June 1961, "Ranger/Agena B Compatibility Test Conducted 29-30 March 1961, LMSD, Sunnyvale, California"

37. JPL Interoffice Memo, E. Kane Casani to F. A. Goodwin, dated 2 June 1961, "Mechanical Match Mate of RA-2 and 6002"

38. JPL Interoffice Memo, W. J. Lane to H. J. Margraf, dated 2 November 1961, "RA-3 Match-Mate Tests"

39. JPL Interoffice Memo, W. J. Lane to Distribution, dated 5 January 1962, "RA-4 Match-Mate Test"

40. JPL Interoffice Memo, W. J. Lane to Distribution, dated 19 July 1962, "RA-5 Match-Mate Tests"

41. JPL Report No. 311-691, "Match-Mate Tests - RA-6", prepared by W. J. Lane/D. Stelma, dated 9 September 1963

42. JPL Report No. 311-697, "RA-7 Match Mate Summary Meeting", prepared by W. J. Lane, dated 21 October 1963

43. Letter to Dr. S. C. Himmel, Lewis Research Center, from H. M. Schurmeier, dated 9 January 1964, Subject: "Spacecraft Adapter Contamination"

44. JPL Report No. 311-705, "Match Mate Tests - RA-8", prepared by W. J. Lane, dated 20 February 1964

45. JPL Report No. 291-724, "Re-Match Mate Tests of RA-8", prepared by W. J. Lane, dated 2 November 1964

46. Letter to Dr. S. C. Himmel, Lewis Research Center, from H. M. Schurmeier (Ref. RA-LV-90251) dated 20 May 1964. Subject: "Results of Repeat Spring Constant Tests at JPL"

47. JPL Report No. 291-730, "Match Mate Tests of RA-9", prepared by W. J. Lane, dated 3 January 1965

48. JPL Interoffice Memo, R. R. Walton to W. S. Shipley, dated November 15, 1961, "Agena Static Firing- SCTB"

49. NASA MSFC TWX, M-L&M-A 9-5, F. Duerr MSFC to J. Spaulding, JPL, dated 19 September 1962

50. JPL Letter, J. D. Burke, JPL, to F. Duerr, MSFC, dated 19 October 1962, Ranger/Agena B, Agena Hot Firings

51. LMSD Document, LMSD/918156, dated 15 March 1961, "Smoke Tests"

52. Memorandum from Durward Brame to Robert E. Pace, Technical Representative (MSFC), dated 3 March 1961

53. Lockheed Interdepartmental Communication, C. F. MacLean to Distribution, dated 27 March 1961, "Materials for Ranger Nose Cone"

54. JPL Report, Un-numbered (L. C. Montgomery), "Preliminary Report on Shroud Smoke Tests Conducted by LMSD

55. LMSC Summary Report, LMSC/A377447/91-38, dated 15 October 1963, "Ranger Block III - Summary Report on Adapter and Shroud Material Outgassing"

56. LMSC Letter LMSC/A603063 from J. L. Shoenhair, LMSC, to Dr. S. C. Himmel, LeRC, dated 23 April 1964, Atlas Retrorocket Exhaust Gas Data for Mariner C"

57. LeRC TWX 9410-1-19 GMB (1965), "Possible Ranger Spacecraft Contamination from Atlas Retrorockets"

58. JPL Letter RA-LV-90294, dated 5 June 1964, "Verification of Dynamic Flight Data for Rangers 8 and 9"

59. LeRC Letter 9421-KFR, dated 22 June 1964, "Meeting to Discuss Verification of Dynamic Flight Data for Rangers 8 and 9"

60. NASA-Lewis Research Center Memorandum dated September 17, 1964, "Minutes of the Meeting to Discuss Verification of Dynamic Flight Data for Rangers 8 and 9"

61. Lockheed Report No. LMSC J-01-65-1, dated February 11, 1965, "End-to-End Calibration of Ranger VIII Dynamic Instrumentation"

62. Lockheed Report No. LMSC J-01-65-2, dated March 17, 1965, End-to-End Calibration of Ranger IX Dynamic Instrumentation"

63. Lewis Research Center Letter 9400-CCC, from Himmel to Schurmeier, dated 16 February 1965, "Agena Project Policy on Dissemination of Documents"

64. JPL Inter-office Memorandum, LV-90094 from M. A. Piroumian to Distribution, "RA/MC Launch-on-Time Experience", dated February 21, 1964, Revised 15 April 1965.

GLOSSARY

ABMA	Army Ballistic Missile Agency
A/C	Attitude Control Subsystem (JPL)
ADC	Analog to Digital Converter
ADF	Aeronutronic Division of Ford
AFETR	Air Force Eastern Test Range
AFSSD	Air Force Space Systems Division
AGC	Automatic Gain Control
AGE	Aerospace Ground Equipment
AMR	Atlantic Missile Range (now ETR)
AO	Building AO (ETR)
ARC	Ames Research Center
ARPA	Advanced Research Project Agency
BECO	Booster Engine Cutoff
BH	Blockhouse (ETR)
CALAC	Lockheed California Company
CC&S	Central Computer and Sequences
CDS	Computer Data System
CG	Center of Gravity
CIT	California Institute of Technology
CKAFS	Cape Kennedy Air Force Station
CO	Spacecraft Coordinator
CR	Central Recorder
CST	Combined System Test
CTS	Central Timing System
CVA	Convair/Astronautics
DAC	Digital to Analog Converter
DPS	Data Processing System (SFOF)
DSIF	Deep Space Instrumentation Facility
DSN	Deep Space Net
DTM	Design Test Model
ECI	Engineering Change Instruction
ECR	Engineering Change Request
EM	Engineering Model
EMI	Electromagnetic Interference
EPD	Engineering Planning Document (JPL)
ESA	Explosive Safe Area (ETR)
EST	Eastern Standard Time

ETR	Eastern Test Range (formerly AMR)
FA	Flight Acceptance
FRD	Flight Readiness Demonstration
FSE	Facility Support Equipment
GDA	General Dynamics Astronautics
GE	General Electric
GMT	Greenwich Mean Time
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
HP	Hewlett Packard
IL	Insertion Loss
IRBM	Intermediate Range Ballistic Missile
IRFNA	Inhibited Red Fuming Nitric Acid
IRIG	Inter-range Instrumentation Group
J-Box	Junction Box
J-FACT	Joint Flight Acceptance Composite Test
JPL	Jet Propulsion Laboratory
KSC	Kennedy Space Center
LC	Launch Complex
LCE	Launch Complex Equipment
LCOSE	Launch Complex Operational Support Equipment
LeRC	Lewis Research Center
LMSC	Lockheed Missiles and Space Company
LMSD	Lockheed Missile Systems Division (now LMSC)
LOX	Liquid Oxygen
L/P	Launch Pad
LPB	Launch Pad Building
LRC	Langley Research Center
MOS	Mission Operations System
MSFC	Marshall Space Flight Center
MTM	Mechanical Test Model (spacecraft)
NRD	National Range Division
NSL	Northrup Space Laboratories
OD	Operations Directive
OR	Operations Requirements
OSE	Operational Support Equipment
PRD	Program Requirements Document
PSD	Power Spectral Density
PSP	Program Support Plan
PTM	Proof Test Model (spacecraft)
QA	Quality Assurance

QC	Quality Control
Rad	Radians
RCA	Radio Corporation of America
RF	Radio Frequency
RFI	Radio Frequency Interference
RMS	Roof Mean Square
RP-1	Rocket Propellant 1
S/C	Spacecraft
SCF	Spacecraft Checkout Facility (ETR)
SCR	Silicon Controlled Rectifier
SCTB	Santa Cruz Test Basin
SFO	Space Flight Operations
SFOD	Space Flight Operations Director
SFOF	Space Flight Operations Facility
SPE	Static Phase Error
SPL	Sound Pressure Level
SSD	Space Systems Division (USAF)
STC	System Test Complex
STL	Space Technology Laboratories (STL)
STM	Structural Test Model (spacecraft)
TA	Type Approval
TAD	Task Assignment Directive
TCM	Temperature Control Model (spacecraft)
TR	Technical Requirements
TV	Television
UDMH	Unsymetrical Di-methyl Hydrazine
USAF	United States Air Force
VCO	Voltage Controlled Oscillator
VECO	Vernier Engine Cut Off